HEATING & VENTILATING

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

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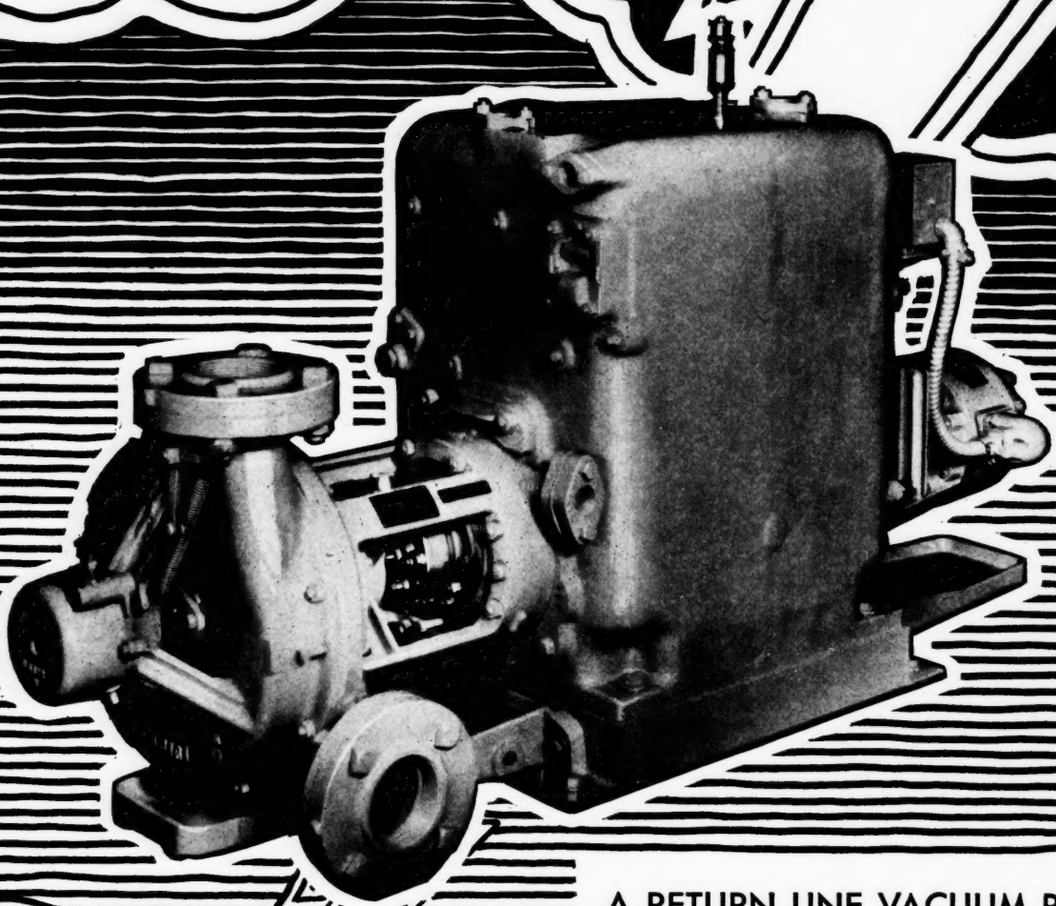

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ECONOMY

Pressure Losses in Rectangular Elbows

Part 1

By R. D. MADISON†

THE purpose of this article is to furnish the designer of duct systems with more accurate data on elbow losses than have hitherto been available and to give him a better conception of where the largest losses occur and how they may be lowered. While it is generally understood that low losses are desirable, there are cases where it may not be necessary or even economical to provide elbows of low loss type. For example, where two runs branch from the same duct or plenum chamber and one run is considerably longer than the other, more attention should be paid to lowering the elbow and other losses in the longer run. Since it will be necessary to damper the shorter run, anyhow, part of the dampering can be effected by the use of a higher resistance elbow, except where it is very close to a register face and quiet operation is essential.

When air flows through an elbow, there is a higher velocity existing in the outer section and a double spiral component of motion is set up. In other words, the air does not follow smoothly around the corner but twists as it turns, and the more abrupt the turn the more energy is thrown into this wasteful form of motion. If there is no duct following the elbow, the increased velocity set up in the latter is dissipated in the room and a high elbow loss ensues. If a duct of two or more diameters in length follows the elbow, part of the energy due to this increased velocity is converted into static pressure and the net loss is not so great as when the elbow discharges directly into a free space. All tests on elbows, therefore, are made in both ways and designated "with" or "without duct" or "elbow only" and "elbow followed by duct." A length equal to four diameters of duct is sufficient to effect practically the maximum available regain of pressure following the elbow but the actual duct friction of this length is not included in the loss of the elbow so tested, but is figured in with the rest of the straight duct.

For many years, designers of duct systems have used the research data of F. L. Busey[1] on pressure losses in round and rectangular elbows. These data were obtained on tests of 12 in. round and 12 in. square elbows of varying radii. Little was known concerning the effect of widening the area to that of a rectangular section, so that all rectangular elbows were treated as if they were of square section. A few years ago, Loring Wirt[2] of the General Electric Company extended test data to include elbows of varying section and radius of curvature. These tests were made on small elbows immediately preceded by nozzles and with air at very high velocity. The results departed greatly from those of Busey, yielding considerably higher values of the losses but, being of a more comprehensive nature, they have been widely used.

Two years ago the writer had occasion to test some large rectangular elbows adjacent to fan outlets. In doing so, it seemed advisable to calibrate the elbows by placing them at a more remote part of the duct system. The results agreed much more closely with Busey's data. At the same time, J. R. Parker instituted tests on smaller sizes in his own laboratory with the idea of clearing up the vague data that existed and also to include the effect of size and velocity of flow on elbow performance. This work was further checked by the writer in the laboratory of the Buffalo Forge Company, and the results were reported in a recent paper.[3] The more important features of the paper will be presented here.

Terms

The following explanation of terms will be needed for a discussion of the paper. Elbows of the same size will be referred to as having the same cross-sectional area. By velocity will be meant the mean velocity, that is, quantity of flow divided by cross-sectional area. Velocity pressure varies as the square of the velocity. Static pressure losses may or may not vary as the square of the velocity, but this will be discussed later under "Effect of Velocity." In any event, it will be convenient to represent all static pressure losses in terms of velocity pressure (or head). Thus, an elbow loss in inches of water pressure, divided by the velocity pressure in inches of water and multiplied by 100, gives the loss in per cent of velocity pressure and is the method of representing loss in the

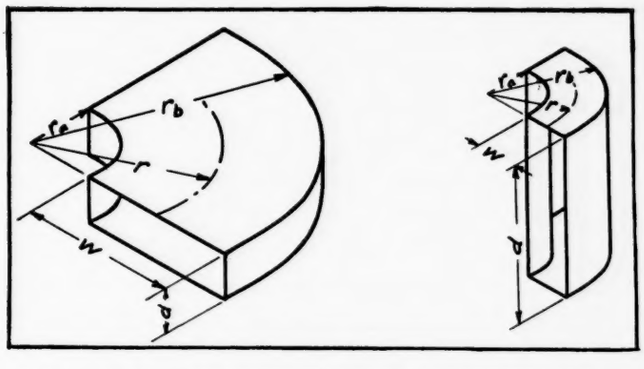


Fig. 1. (Left) Low aspect ratio elbow (hard bend). Fig. 2. (Right) High aspect ratio elbow (easy bend).

†Buffalo Forge Co., Buffalo, N. Y.

[1]"Loss of Pressure Due to Elbows in the Transmission of Air Through Pipes and Ducts," by F. L. Busey, *Trans. ASHVE*, Vol. 19, 1913.

[2]"New Data for the Design of Elbows in Duct Systems," by L. Wirt, *General Electric Review*, Vol. 30, June, 1927.

[3]"Pressure Losses in Rectangular Elbows," by R. D. Madison and J. R. Parker, *Trans. ASME*. Vol. 58, April, 1936, paper AER 58-2.

accompanying curves. Radius ratio of an elbow (abbreviated RR) is the center line radius divided by the width in the plane of the bend. It is equal to r/w in Figs. 1 and 2. Curve ratio (CR) is the inside radius divided by the outside radius, or r_a/r_b. Above 0.5 radius ratio, the following relations may be written:

$$CR = \frac{RR - 0.5}{RR + 0.5}$$

and

$$RR = 0.5\left(\frac{1 + CR}{1 - CR}\right)$$

Aspect ratio (AR) equals the distance along the axis of bend divided by the width in the plane of the bend, or d/w. Thus, in Fig. 1, d is less than w, the elbow has an aspect ratio less than one and it is frequently referred to as a "hard bend." In Fig. 2, d is greater than w, the elbow has an aspect ratio greater than one and is referred to as an "easy bend."

Duct friction, with reference to elbows, will be defined as that part of the elbow loss which is similar to straight duct friction (in contrast to shock or turbulent loss). A splitter is a 90° curved vane the full distance across the elbow and constructed with the center of curvature the same as the outside and inside radii of the elbow. Turning vanes are a series of small curved vanes placed across the corners of a square corner elbow. Generally, they are constructed of a single thickness of metal. In some cases, they are composed of two thicknesses of metal in such a manner that the outer and inner radii of adjacent vanes are concentric.

Comparative Curves

While it has been customary to plot elbow losses against radius ratio, the author has chosen to plot them against curve ratio (with equivalent radius ratio given at the top) since a better distribution of the plot is effected and splitter calculations are greatly simplified. The results of various experimenters are given in Fig. 3. Zero curve ratio given at the left is for an elbow with a sharp inside corner and an outside radius about this corner. Unity curve ratio at the extreme right is for an elbow of infinite radius, that is, a straight duct. Curve H at the right is the theoretical duct friction for a 90° elbow based upon a loss of one velocity head in 55 diameters of 12 x 12 in. straight duct (the side of a square duct being equivalent to a diameter or, in the case of a rectangular duct, 2ab(a + b) where a and b are the sides). The author's curve, C, is shown blending into this duct friction curve approximately by the dotted line and will obviously never drop below it. Thus, a 90° elbow of very large curve ratio will, by virtue of its great length, have a substantial pressure loss.

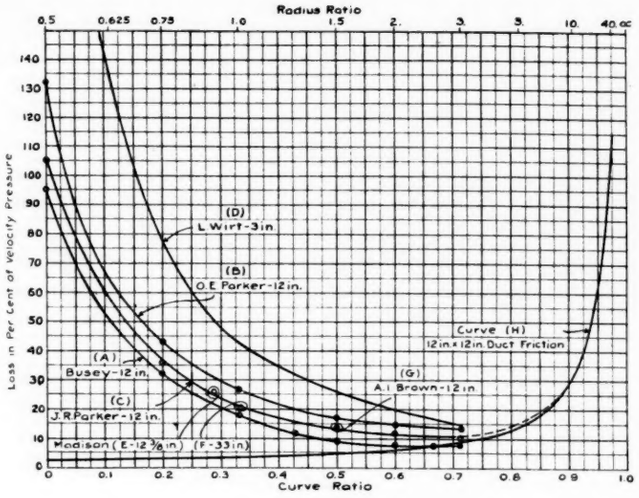


Fig. 3. Pressure loss in 90° elbows followed by ducts as reported by several investigators.

Curve D, by Wirt[2], is of a 3-in. size but, as we shall see later, size does not materially affect the loss below 0.5 curve ratio and we may compare it in that region with other tests on 12-in. elbows. The great similarity of curves A, B, and C probably indicates the true trend of the loss for elbows of various curve ratios.

Effect of Size

Curve C is again reproduced in Fig. 4, together with tests on 3- and 6-in. elbows of square cross-section. The duct friction curves at the right are based upon the close assumption that the friction varies inversely as the $^1/_7$ power of the size. Test points on 3-, 6-, and 12-in. elbows of 0.717 curve ratio (3 radius ratio) show a characteristic spread to meet the friction curves. Below 0.5 curve ratio, the greater part of the elbow loss is due to turbulence rather than duct friction, and below 0.3 curve ratio, the effect of size becomes nil, as may be seen by the 3- and 33-in. sizes falling upon the same line. For an elbow of 0.5 curve ratio (1½ radius ratio) and square cross-section the curve shows a probable loss of between 10 and 15% velocity pressure, depending upon the size under consideration. Some of the elbows tested for size are shown in Fig. 5.

Variation of Loss Due to Velocity

The effect of velocity of flow on pressure loss in elbows seems to be relatively unimportant for the velocities ordinarily used in air conditioning work. Tests were run at velocities ranging from 1,800 to 4,000 f.p.m. Those reported in this article are at 1,800 f.p.m. While it has been generally considered that the absolute loss (in inches of water) varies as the square of the velocity pressure and, therefore, the loss in per

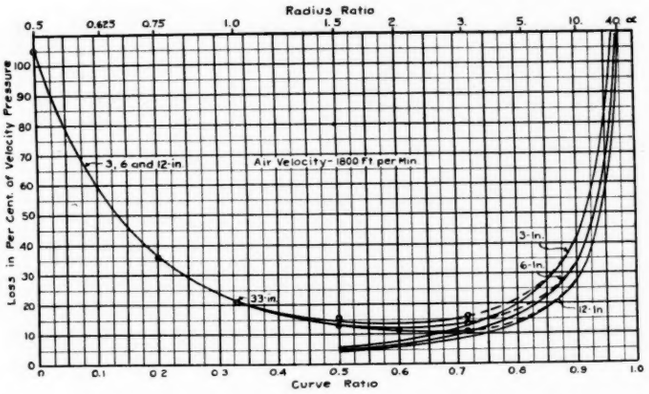


Fig. 4. Effect of size on pressure loss in 90° elbows of square cross-section.

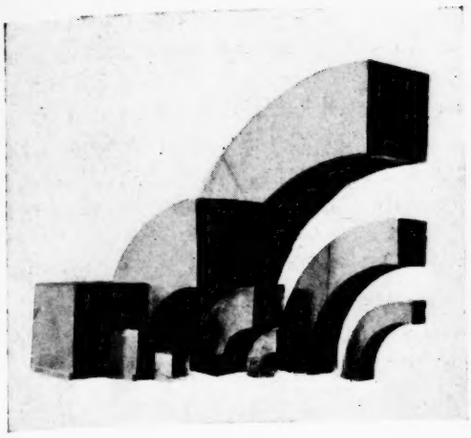


Fig. 5. (Left) Elbows of various sizes as tested by the author.

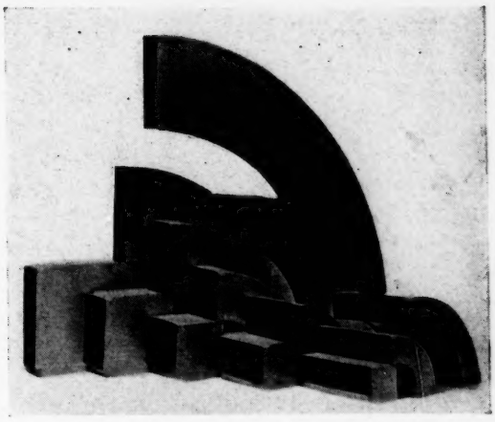


Fig. 6. (Right) Elbows of various aspect ratios as tested by the author.

cent of velocity pressure is a constant, this is only true for elbows of very high shock loss and relatively small surface. As a test on this type, a 3 x 12 in. elbow was selected with 0.5 radius ratio (zero CR) and an aspect ratio of 4. The actual loss varied as $V^{1.92}$. That is to say, if the elbow had 0.25 in. loss* at 2,000 velocity, it had 0.95 in. at 4,000, instead of 1 in. (according to the square law). On the other hand, a 3 x 12 in. elbow with 3 radius ratio (0.71 CR) and an aspect ratio of 0.25 has 24 times the surface of the above elbow and the loss in this case varied as $V^{1.76}$. Here, a loss of 0.25 in.* at 2,000 f.p.m. would be 0.85 in. at 4,000 f.p.m. This is even less than the accepted law for straight duct friction in square ducts. For velocities higher than 9,000 and lower than 800 these data should be used with caution until further research is made. The writer believes that the loss varies as a function of the relative degree of turbulence and surface friction, approaching the square law as the turbulence predominates.

Non-Uniform Distribution

If the velocity distribution across the duct preceding an elbow is not uniform, there will be a difference in the recorded loss. Where the velocity is higher than normal on the side next to the throat or inside radius, the loss will be somewhat higher than shown in these tests and where the higher velocity is on the outside, the loss will be lower. This principle is of special importance in connection with the use of an elbow immediately attached to a fan outlet. The velocity of air leaving a fan is usually highest along the outside of the scroll and if the throat of the elbow is placed adjacent to the high velocity flow, the loss may be as much as twice the normal loss.

*These are not test values but are given to show only the comparative variation of loss with velocity.

Where possible, the elbow should continue the same direction of flow as in the fan, in which case the loss may be only half normal value. In either case, an elbow of generous curve ratio is desirable in this position. Where a fan has unstable pressure characteristics, an elbow reversing the curvature of flow is likely to affect fan performance and cause "hunting." Where an elbow makes a side turn away from a fan outlet, the variation in loss is less serious. With single inlet parallel blade fans, the velocity is usually higher on the backplate side. In conical blade fans, or fans with inlet guide vanes, the velocity may be higher in the center or on the inlet side, depending somewhat upon the fan rating.

Effect of Aspect Ratio

Up to this point, we have been concerned with elbows of square cross-section (unity aspect ratio). Tests on four other shapes, namely ¼, ½, 2, and 4 aspect ratios were carried out to determine the influence of rectangular section upon the loss. Both high and low radius ratios were used in these experiments and some of the elbows tested are shown in Fig. 6. To eliminate the factor of size, all elbows in this group of tests had the same cross-sectional area, 36 sq. in. Fig. 7 shows the aspect ratio factor based

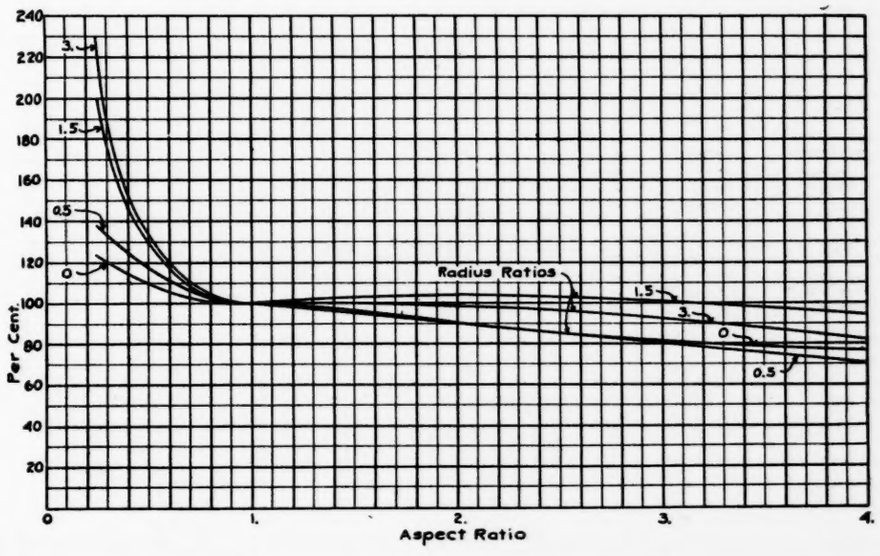


Fig. 7. Pressure loss in per cent of that for unity aspect ratio.

upon unity aspect ratio as 100%. Thus, to obtain the elbow loss in per cent of velocity pressure, the loss due to curve ratio (or radius ratio, whichever is the easiest method of selection) is multiplied by the aspect ratio per cent divided by 100.

Contrary to the findings of Wirt, the aspect ratio factor cannot be represented by a single curve, but shows a marked influence of the radius ratio. Moreover, instead of a decided slope of the curve through one aspect ratio, the trend is practically horizontal at this point and continues so for some distance. This characteristic was also observed in tests on large elbows (28 x 38 in.) in which the loss was slightly less for the 0.74 aspect ratio than for 1.36. Since these proportions are typical for many fan ducts, it is enlightening to know that within these limits there is not much difference in the loss which way the bend is made, provided the radius ratio is the same in either case. Obviously, the easy bend will have less actual distance of offset from face to center line of elbow for a given radius ratio, as well as less surface. Below 0.6 aspect ratio, the loss rises rapidly for the shapes of elbows commonly used and some form of improvement, such as splitters, is indicated. The flatness of the aspect ratio effect suggests the best location for splitters and this will be taken up in the paper to follow.

As an example of the use of these curves, consider an elbow of 6 x 18 in. cross-section with an aspect ratio of 3 and radius ratio of 1½. The area is 108 sq. in. or between the 6- and 12-in. curves of Fig. 4 from which we obtain a loss of 13.5% velocity head. From Fig. 7, for an aspect ratio of 3, we obtain a factor of 97%. 13.5 x 0.97 = 13.1% velocity head loss to be expected at 1,800 f.p.m.

[To Be Concluded]

Use of Brine for Absorbing Irritant Refrigerants in Air Conditioning Systems

A CONTROVERSY has been under way for more than a year regarding the proposed safety laws in New York, whereby air conditioning in most types of buildings must be by an indirect method, to avoid the so-called panic hazard. Restrictions are so drawn that the old-time refrigerants, sulphur dioxide and ammonia, are virtually ruled out, since a double indirect scheme is advocated for them by the Fire Department officials.

Apparatus was set up by the Virginia Smelting Company to show that SO_2 can be safely used in a simple indirect system by using a suitable brine in place of water in the air conditioner. It appears from this development that brine has some inherent advantages for this work, and that its difficulties in application have been overcome by the experimenters.

This unit, as installed, represents hypothetically what would in practice be a gas-tight machinery room as specified in this proposed code for New York. The equipment, assumed to be in the machinery room, consists of a liquefying unit and a brine cooler. The brine cooler is in the form of an open tank which permits the observation of the brine and the absorption of the refrigerant in the brine after the artificial leak is opened up. A partition separates this part of the equipment, supposed to be in the machinery room, from the air washers, which would actually be in the space to be conditioned or connected with it by air ducts.

The unit was operated during the weeks of January 27 to February 1 and February 3 to February 8 of this year. Two different absorbent brines were demonstrated. One consisted of caustic soda dissolved in water in various concentrations from 1 lb. to the gallon down to ⅛ lb. to the gallon. In all concentrations used, the absorption was complete with the artificial leak valve wide open, and also while adding liquid sulphur dioxide from a cylinder direct to the brine cooler, which addition was made to the extent of 40 lb. in 3 min., no odor of sulphur dioxide, which was used as a refrigerant, could be detected in the air leaving the washer. A bottle containing aqua ammonia was passed in front of the exit air stream and also over the brine cooler and no trace of sulphur dioxide could be observed.

Solutions of dichromate in varying strengths from ½ lb. down to ⅛ lb. to the gallon were also used in the washer. Absorption of sulphur dioxide with the artificial leak valve wide open was noted in all cases and proved as previously mentioned with ammonia.

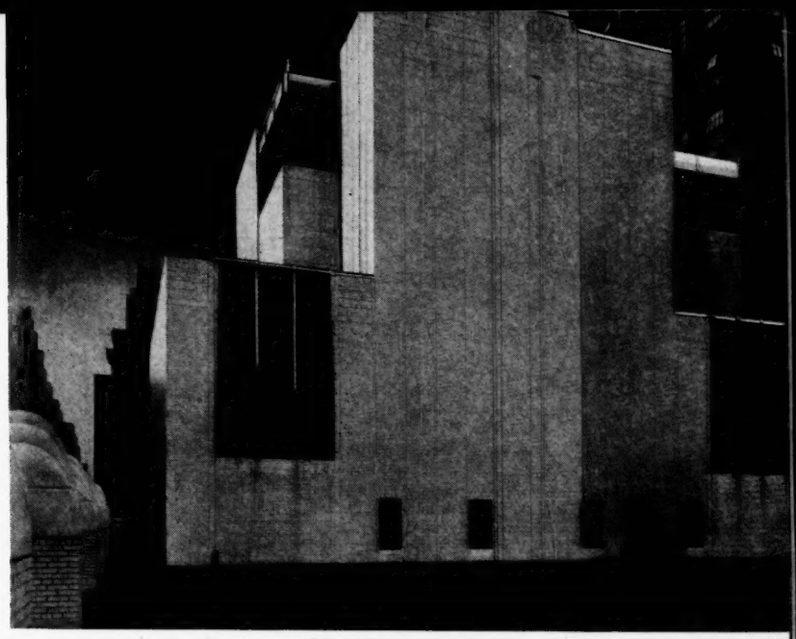
The absorption with a caustic brine is in accordance with the following reactions: $2NaOH + SO_2 = Na_2SO_3 + H_2O$. 1.25 lb. NaOH absorbs 1 lb. SO_2. The Na_2SO_3 is a neutral salt and should not be confused with the sodium bisulphite which is formed when NaOH is added to a solution of sulphurous acid.

The absorption with dichromate is in accordance with the following reactions: $Na_2Cr_2O_7$, $2H_2O + 3SO_2 = Cr_2(OH)_2(SO_4)_2 + NaSO_4 + H_2O$. 1.55 lb. of dichromate absorbs 1 lb. SO_2.

The Virginia Smelting Company has recommended the adoption of an amendment to the proposed code of ordinances of the City of New York relating to refrigerating systems which would permit the use, in any type of building, of an irritant or flammable refrigerant provided the refrigerating equipment and the brine cooler are in a gas-tight engine room as defined in the code and provided further that an absorbent brine is provided of such a nature and in such quantities that it can absorb at least twice the total volume of refrigerant present in the system without itself becoming irritant or inflammable.—*Refrigerating Engineering.*

Heating and Cooling Kress' Fifth Avenue 5, 10 and 25

By A. F. CROWLEY†



Air conditioning equipment in the Kress store is housed in the penthc Note size as compared with the door.

LAST year saw the erection at Fifth Ave. and 39th St., New York, of one of the largest stores of the S. H. Kress & Company chain of 5, 10 and 25 cent stores. Built on one of the most famous landmarks in New York, the site of the Wendel mansion, it had added interest because the expensive location was such a unique departure for a low-price store. Long before it opened public interest was aroused, and when finally opened in October the beauty and completeness of the building made it the show place of the Avenue.

Building

The building is seven stories high with a penthouse extending four stories above the main roof. The entire building is constructed of white marble and granite. Entrances, show windows, trimming, and marquees are of bronze.

Basements: Below the street level there are four basements, extending down to solid rock. The first basement is given to a sales floor of 13,000 sq. ft., and a soda and lunch department.

The second basement is a spacious and attractively decorated cafeteria and a flower shop. The third basement comprises the kitchen, steward's office, storerooms, dishwashing room, refrigerator boxes for various foodstuffs, ice cream hardening rooms, and a completely equipped laundry.

The fourth basement contains the boiler room, pump-room, refrigerator room, ice plant, and incinerator.

Main Floor: Of unusual interest is the main sales floor, because of its 14,000 sq. ft. of floor area unmarred by columns. The support for the second floor is from trusses located in the third and fourth stories.

The distinctive lighting effect of the main floor is achieved by the ceiling lighting design and the high foot-candle power, which gives a daylight brilliance without glare. The direct lighting is all in the ceiling, the indirect comes from fixtures hung from the ceiling and behind wall fixtures. The ceiling is 25 ft. high, access to the lighting fixtures being through the attic space in which they are located. Side walls and ceilings are illuminated by reflectors concealed behind the moulding of the wall display cases. The total wattage for the main floor is 209,000, a considerable factor in the air conditioning load of this floor.

Upper Floors: The office, stock receiving room, employes' locker and rest rooms are on the second floor. The rest of the building consists of stock rooms for all the merchandise carried in the store.

Air Supply and Exhaust

The air conditioning system, located on four floors of the penthouse, consists of four main supply fan units, data on which are given in Table 1. The basement fan takes care of the sales basement, soda and lunch department, and the cafeteria on the floor below.

The kitchen fan supplies conditioned air to the third basement, including the laundry and dishwashing room. The first floor fan supplies the main sales floor. The second floor fan conditions the entire second floor, the ladies' lounge on the mezzanine, and the candy storeroom on the third floor.

Return air fans, except for the kitchen, exhaust the air from the conditioned areas and connect with the supply fans for recirculation, or exhaust through relief dampers to the outside if not recirculating. Exhaust from the kitchen and the restaurants is not recirculated, so that only fresh air is used for these areas and there are never any food or smoking odors.

Load: The various fan units were designed with certain conditions of occupancy and electric wattages in mind to estimate as a given heat load, and assuming that the building is reasonably tight and all doors, windows, and other openings except public entrances kept closed for the purpose of preventing infiltration of air. See Table 2.

Cooling

Two 280-ton centrifugal compressors, with cold water and cooling tower circulating pumps are located on the eighth floor, as is the engineer's office. 350-hp. motors, slip ring type, drive the compressors. A multi-speed controller, manually operated, gives the necessary flexibility in handling load variations.

†Chief Engineer, S. H. Kress & Co. Store, Fifth Ave., New York.

TABLE 1—FAN DATA

Fans								
Unit No.	Service	C.F.M.	Static Pressure, In.	R.P.M.	Hp.	Outlet Velocity, F.P.M.	Motor	
							R.P.M.	Hp.
1	Kitchen	25,000	2¼	756	12.6	1,910	1745	15
2	Basement and Cafeteria	47,350	2¼	486	23	1,610	1750	30
3	1st Floor Sales	40,000	2¼	554	20.2	1,720	1740	25
4	2nd Floor Sales	32,000	2¼	620	15	1,790	1800	20
5	2nd Floor Exh. and Ret.	25,000	1	585	6.3	1,910	1730	10
6	1st Floor Exh. and Ret.	25,000	1	585	6.3	1,910	1730	10
7	Basement Ret.	18,350	1	530	4.7	1,850	1730	7½
8	Cafeteria Exh.	19,000	1	523	5.06	1,920	1730	7½
9	Soda and Lunch Exh.	10,000	1	618	2.7	1,650	1735	5
10	Attic Exh.	10,000	1	618	2.7	1,650	1160	5
11	Show Window Exh.	2,400	1	1,461	.63	1,900	1740	1

The two cooling tower fan rooms are on the ninth floor. The cooling towers for supplying condensing water to the refrigerating machines are built into the shell in the building. They are 51 ft. high and extend from the ninth floor to the roof of the penthouse; the baffles are constructed of California redwood, with spray eliminator baffles over the top.

Each tower is designed to cool 1,125 g.p.m from 93F to 85F at an outside wet bulb temperature of 75F. The fans are 72,000 c.f.m., eight bladed, 9 ft. diameter axial flow propeller type, driven by 15-hp. motors.

All the conditioned air supply systems are equipped with sprays for humidifying in the heating season. The spray pump, using water from the house tank on the eleventh floor, discharges water to the sprays at 20-lb. pressure.

Control

All four supply systems are equipped with a completely automatic control. The main control for each system is the recording temperature controller mounted on the instrument panel in the engineer's office.

This installation is particularly interesting because one master reset controller with its bulb in the fresh air intake regulates the rate of reset on the four unit controllers. The object of the reset is to maintain a definite comfortable relation between the indoor and outdoor temperatures during summer. When the outdoor temperature is above 74F the control automatically causes a 1F rise indoors for every 3F rise outdoors, regardless of the number of shoppers in the store. When the outdoor temperature is below 74F the instruments maintain straight temperature control at a fixed point. This takes care of winter comfort. These individual controllers regulate, by means of air pressure, the return air dampers and the return air reheater coils in the one action, and this control is actuated by the temperature of the floor.

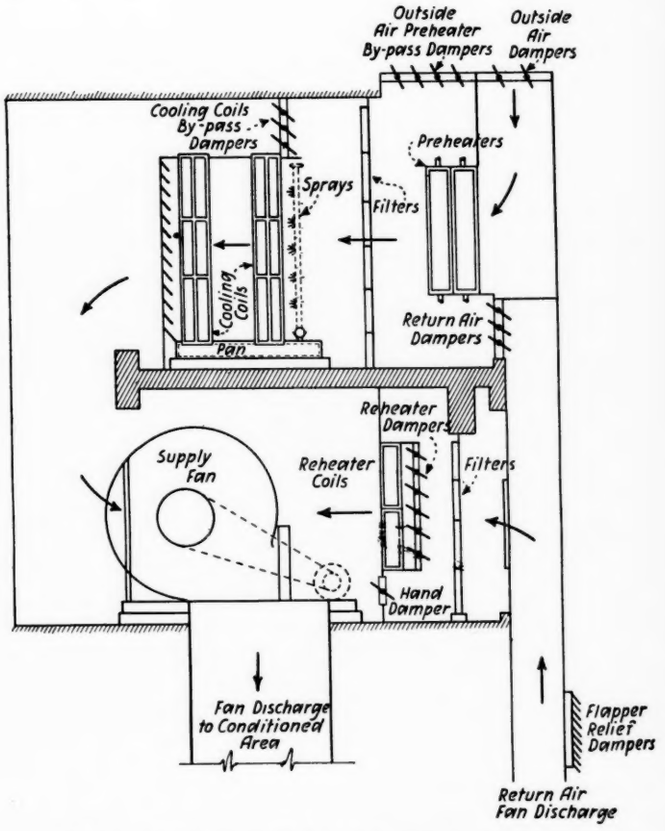
TABLE 2—AIR CONDITIONING LOAD FROM PEOPLE AND LIGHTS

Space	No. of People	Lights, Kw.
First Floor Sales	1,500	209
Basement Sales, Soda and Lunch, and Cafeteria	1,250	100
Second Floor	700	40
Kitchen	25,000 c.f.m. and 90 tons of refrigeration	

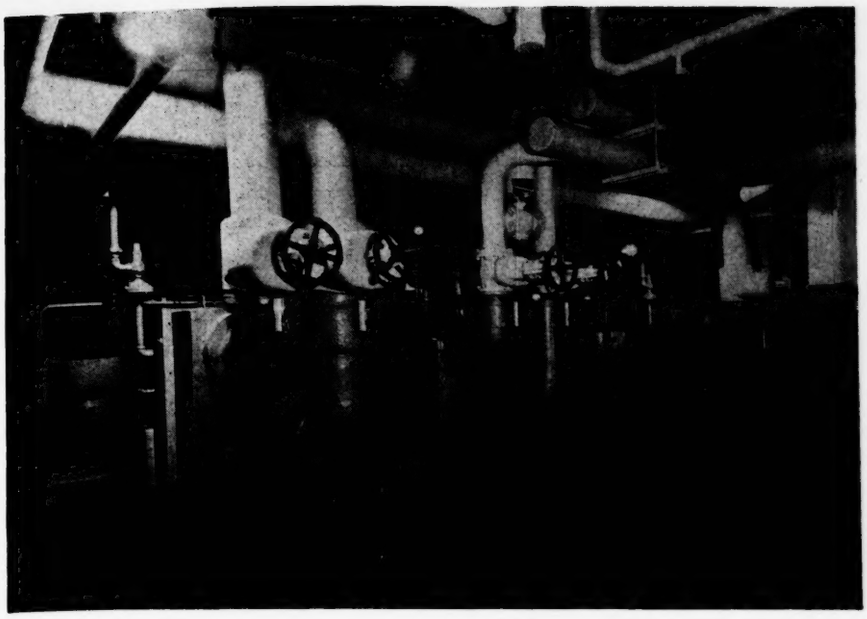
The other instruments on the panel are recording thermometers for chilled water temperatures in and out, condenser water in and out, and an outside wet and dry bulb recorder. Pilot light indicators show the operation of all fans, compressors, cooling towers. Push-button damper control is also located on the panel.

An unusual feature of the control operation from the panel are the pushbuttons which can shut down the entire air conditioning plant instantly in an emergency. They are connected with the circuit breakers for the various units and power panels, which are on the main distribution board in the second basement. However, none of the units can be started from the panel. The operator must start each unit, and in being right there he can observe that everything is functioning properly.

Another interesting feature of the control system is the additional sets of dampers opened from a button on the panel to provide for handling a greater volume of outside air in the intermediate seasons between heating and cooling. A set of outside air dampers is opened,



Schematic diagram of the air conditioning system



The compressor room located in the penthouse on the roof of the Kress store

which bypass the preheater coils, and dampers over the cooling coils are opened to give greater area for the increased air volume. In the same operation, by means of a relay, the return air dampers close and 100% outside air is used, except for the hand damper return air heater bypass, which may be set at any position to allow a slight amount of recirculated air. This is known as the intermediate season control. The return air is exhausted through relief flapper dampers to the outside.

The outside stack of preheaters is set to open at 34F by thermostatic control. The inside stack operates on the dewpoint thermostat located beyond the eliminator plates. Kitchen supply air reheater, and the other fan units' return air reheaters are controlled automatically by setting the fan controller on the panel board.

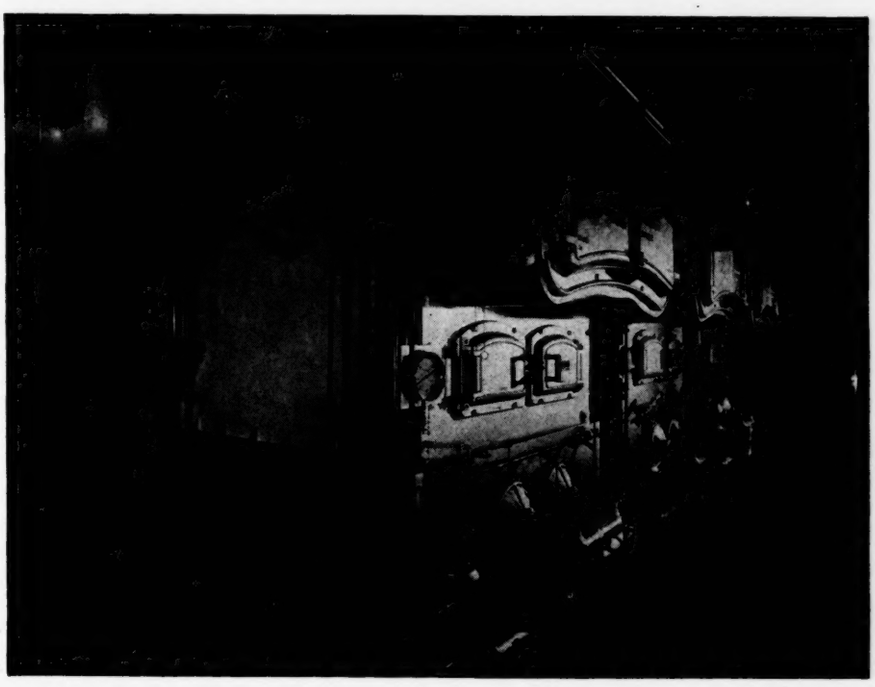
Reheaters and volume dampers are located in various conditioned areas, actuated by thermostats, to take care of temperature variations caused by fluctuating numbers of shoppers. Dampers supplying air to the cafeteria are controlled from the engineer's panel board by pushbutton so that when the day's business in the cafeteria is over the dampers may be closed, and the air used in the sales basement and soda department.

Filters of the washable type are used in all the fan units, for both outside and recirculated air. Washing sinks are located in the same levels as the filter banks to reduce the amount of handling incidental to cleaning.

Window Ventilation: An unusual feature of the air conditioning system is the ventilation of the show windows. The nine show windows have a total of 29,700 watts in lighting. If provision were not made for adequate ventilation, it can be seen that perishable goods, such as candy, could never be displayed. Each window has exhaust grilles leading to a common duct; the air is pulled by the show window exhaust fan on the seventh floor, and discharged on the roof. The supply to each window is so arranged that by means of a damper the window may receive either street air or air from the store. Filters located in the duct to each window clean the air and keep the displays clean. With this arrangement the show window temperature can be regulated sufficiently to allow the display of any merchandise. Even grass has been grown in one of the windows, an accomplishment which required proper ventilation.

The show window exhaust fan is connected in series with the time clock which in turn is connected to the show window lighting circuit. The time clock cuts on the lights, and with it the exhaust fan, and cuts them out at the set hour at night. The settings may be changed to provide for any schedule of lighting.

The system of cooling used is the surface type, and



Three oil-fired steel boilers are located in the basement. A photo-electric cell in the boiler breeching flashes a red light when smoke shows.

the chilled water is circulated through two separate banks of four rows of coils in each fan unit. A complete water circulation between the refrigeration machines and the four sets of surface coils is maintained, but the fans are so valved for water flow that any unit can be cut out of the circulation. In addition, a water bypass valve is located at the inlet to each of the sets of coils, actuated by air pressure from the dewpoint thermostat. If the air temperature falls below the set point, the bypass valve opens and the chilled water bypasses that set of coils until the temperature rises and the thermostat closes the bypass valve. This is the same thermostat that controls the steam valve to the second bank of preheater coils during the heating season.

Heating

The freight corridor on the main floor and the stock floors are heated by unit heaters. In addition, each stock floor has two ventilating units, complete with dampers and heating coils for automatic temperature control. Recirculated air is mixed with outside air to give the desired temperature.

The stock floors have three unit heaters, spaced along the two outside walls of the building for wall heat loss and window leakage. Thermostatic steam valves, with the bulb located on the wall, control the admission of steam to the heater. The starting switch with three-speed controller is located on the wall adjacent to the heater.

Direct radiators are used in the second floor office, the employes' locker and rest rooms, the candy storage room on the third floor, and the various washrooms on the stock floors. There are no direct radiators below the second floor.

Heater blast fans are located over the Fifth Avenue and the 39th Street entrances, discharging into the vestibules and revolving doors. At night when the air conditioning system is shut down, these units are sufficient to keep the entire main floor warm.

The heating system was designed to maintain 70F on the floor of the stock rooms with an outside temperature of 0F. During the past winter when the outside temperature reached 0F the floor temperatures were checked at 70F.

A feature of the heating design is the attic exhaust fan which removes the warm air from the attic space over the main floor. Due to the intensity of the lighting in this space, the air becomes heated and would act as a blanket if it were not removed. The fan, with two-speed controller, is located on the ninth floor. The attic heat is utilized for main floor heating during the winter by not running this fan, but when cooling it is necessary to run it.

Boiler Plant: The boiler plant consists of three 190-hp. H.R.T. oil-burning boilers operated at 15 lb. pressure. The burners are of the gun type. A steam pressure regulator is connected to the air registers and fuel oil valve by means of a rod and lever arms. When the pressure drops to a set point, about 13 lb., the air registers are opened up, with the fuel oil valve, and the fire increased. As the pressure rises above this setting the regulator cuts down the fires until the pressure drops.

The boilers are equipped with a low water automatic oil cutoff, and an automatic feed float switch which starts the condensate pump (the boiler feed pump), and cuts it off at set levels. All the condensate is returned by gravity to the condensate tank. Boiler make-up is fed into the condensate tank by means of a float valve.

From the main steam header, lines are run to the heating system, to the kitchen, to the hot water heaters, and to other smaller services.

A boiler is left on the line for one month, after which it is taken off, cleaned, brickwork repaired where necessary, filled up with water and laid up for two months. This keeps all boilers clean and in condition.

The kitchen hot water heater has a storage capacity of 950 gal. and a heating capacity of 2,700 gal. per hr., from 40F water to 160F. The kitchen demand reaches a peak of 2,400 gal. per hr. after the lunch hour. Thermostatic bulb in the tank controls the steam valve to maintain a constant discharge temperature from the heater. By lowering the bulb in the tank the steam valve opened and closed more frequently and helped maintain a steadier load on the boiler.

A photo-electric cell in the boiler breeching rings an alarm and flashes a red light when smoke is made. This feature has cleared up any smoke problem by calling the fireman's attention immediately to the necessity of an adjustment of the oil valve or the cleaning of a burner.

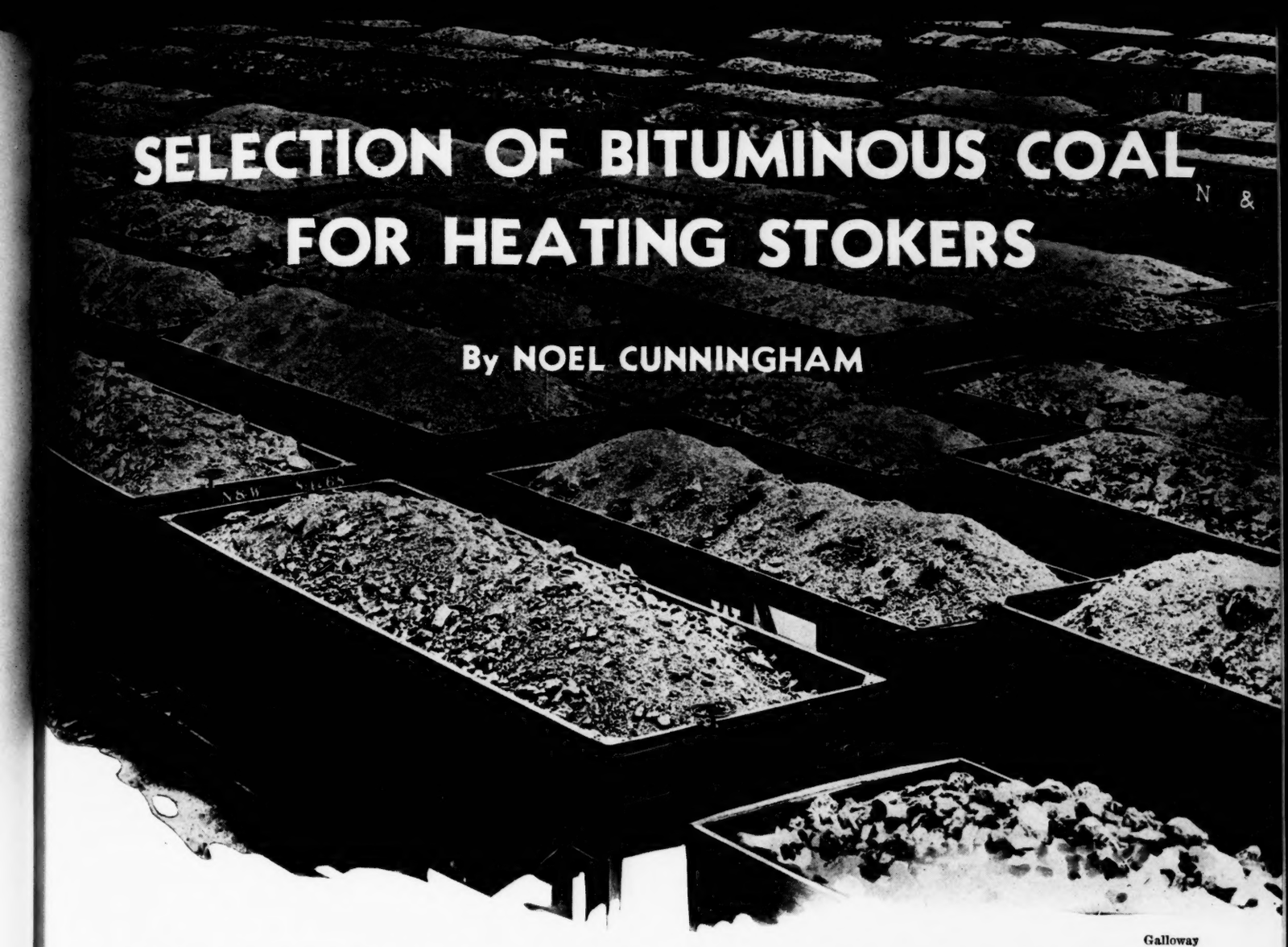
A balanced damper located in the boiler room maintains a constant draft in the boiler flue regardless of atmospheric conditions.

The consulting engineers on the building were Jaros, Baum and Bolles; the architect, Edward F. Sibbert.

The Kress store, Fifth Ave. and 39th St., New York

SELECTION OF BITUMINOUS COAL FOR HEATING STOKERS

By NOEL CUNNINGHAM



Galloway

MORE intensive study has been given during the last few years to the problem of bituminous coal combustion in connection with its use in heating stokers than to all phases of combustion during all the years previously that this coal has been used as fuel. Much has been learned but little has been definitely proved. This is not strange for, of all the products of nature, bituminous coal is probably the one which contains the most variables grouped under a single classification.

The last few years have seen a considerable introduction of automatic coal burning in homes and, with the assurance that upon public acceptance of automatic coal heating depends the future prosperity of the coal industry, coal producers, for the first time have really begun to study what has heretofore been of minor importance both to themselves and to coal users. Before, sizing and cleaning coal was the whole problem of preparation. About all the large user asked for was a high B.t.u. content. The household requirement was a maximum of lump coal content. Sized lump was the desirable heating fuel and clean slack was industrial fuel. Proportional content of volatile matter was an important further consideration only as smoke elimination was more or less stressed. The literature on coal combustion was almost wholly concerned with means for securing smoke abatement.

Coincident with the realization on the part of coal producers that heating with stokers is the key means of renewed prosperity in the coal industry was the drive by the stoker interests for elimination of costly service troubles traceable to undesirable coal characteristics. The stoker interests found that some coals which are most acceptable with hand-fired heating plants are very troublesome when used in heating stokers, while coals heretofore considered undesirable often gave less trouble stoker-fired than did the output of established producers of premium coal.

This situation started the producers of both high grade coal and coal of lower grades into intensive competition for what was at once realized to be of immense future importance—the market in coal for automatic stoker use. Unwarranted claims were made on all sides and it was very evident that neither coal producers nor the stoker interests had clear ideas of what effect certain coal characteristics have in combustion, especially when the coal is introduced into the fuel bed underfed and subjected to intensely localized forced draft. An immense amount of research has been carried on and much good work has been done and much more is still to be done; it will be some years yet before all the problems are solved and, in the light of present knowledge, it is doubtful if any definite specification can be made of an ideal automatic stoker fuel.

The country over the question which everyone in the coal business and in the stoker business is being asked is, "What is the best coal for stoker use?" It is a question that will be answered glibly by many coal and stoker dealers. Supplies of entirely unsuitable stoker

coal laid in for the coming heating season will be very costly to the user and to everyone else before they are finally disposed of. In most cases ways will be found to burn supplies of troublesome coal but not without stress on tempers and pocketbooks.

If it is fully understood just what the present problems are in selecting a stoker fuel there will be a minimum of difficulty. It is something that should be thought out carefully both by large users who risk a considerable investment and by householders who can ill afford to take chances. In what follows, the factors which should be considered are listed and discussed. A few definite recommendations are made but the idea chiefly is to state the variables and their interbearing so that those interested may reach helpful conclusions as to what best suits individual and local conditions.

The Best Size

The proper size to buy depends chiefly upon the stoker. Not many stokers are made which cannot handle 1¼ in. maximum. A few manufacturers put out small stokers with screws less than 3¼ in. diameter and for these maximum size should be ¾ to 1 in. Screws 3¼ in. and larger will handle coal up to 1¼ in. maximum. Screws 4 in. and larger will handle up to 1½ in. maximum, while stokers having 4½ in. and larger screws can take 2 in. maximum which is the largest size of bituminous stoker fuel. Various coal producers are preparing special stoker fuel in sizes ¼ in., ½ in., ¾ in., 1 in., and 1¼ in., with all or part of the dusty element removed, and these special coals usually sell at somewhat higher prices than "screenings" which are produced by passing through definite sized screens all the material in the coal which will go through the screen opening. The usual sizes of screenings, maximum, are 1¼, 1½, and 2 in., which means that they are made up of all the material in the coal finer than these sizes. Screenings are variable as the amount of fine element depends upon the friability of the coal, a quality which varies considerably.

It is not necessarily true that the very fine element in this coal is troublesome and it has one advantage in acting to fill the interstices between larger particles and allowing a low chimney draft to be carried without "smoke back" through the coal feed tube. With not over 20% of very fine element, maximum size within the capacity of the screw is not an important factor except as price is affected. No definition is at present accepted as to what size classification to place on the fine element but it may be taken for present purposes as that portion which will pass through a 10 mesh screen.

To summarize: Provided the coal contains not over 20% of smaller than 10 mesh material, coal of any maximum size that will handle well through the coal feed screw will be satisfactory subject to the limitations introduced in considerations which follow.

Price Considerations

The lowest priced stoker coal is screenings, definition and sizes of which have been previously stated. The price of screenings f.o.b. mine, the country over, is fairly uniform so the freight rate usually governs delivered price. What has been said regarding maximum size and proportion of fine element has an important bearing; no matter how low the per ton price may be, a coal containing excessive fine element is to be avoided. Of course, in buying coal, it should be on the basis of its heat content, but it is seldom practicable to specify this in domestic purchasing and few coal dealers actually know the correct B.t.u. value of the coal they handle. The day will come when this will be a certified characteristic but it is not usually reliably specified at the present time.

Screenings from the nearest producing area, of any maximum size suitable to the stoker to be served, with not over 20% smaller than will pass a 10 mesh screen, should be a satisfactory stoker fuel. Removal of fine element to reduce the proportion to not over 10% should add (roughly) 40 cents per ton in effective value of stoker fuel. As between two coals of equal sizing, each additional 1,000 B.t.u. per lb. should add (roughly) 50 cents per ton to the effective value. Oil treatment which is discussed later is well worth the 10 cents per ton which is usually charged.

Summarizing: Subject to considerations yet to be discussed, the price of domestic stoker coal should be in definite relation to what reliable coal dealers are charging for screenings from the nearest producing source and should have not over 20% of material which will pass a 10 mesh screen. It will be an economy to pay (1) for a reduction of 10% in content of fine element, up to 40 cents per ton, or in that proportion for a greater or lesser reduction, (2) up to 50 cents per ton for an increase of 1,000 B.t.u. per lb., or in proportion for a greater or lesser increase, and (3) 10 cents (or even more) for oil treatment (yet to be discussed).

Available Heat

In general, the heat value of coal in the United States decreases progressively from east to west. The extent of preparation to which coal is subjected at the mine modifies this basic characteristic, but given equal preparation and identical ash content, the farther east the source of coal the higher its heat value. The time will come when most coal for stokers will be identified by trademark and certified as to heat content, but few certified coals are at present generally available. As has been stated, any additional heat value in coal increases its worth to the customer but sampling difficulties and the cost of having B.t.u. determinations made render it impracticable in most cases to check small deliveries in this particular. If the coal is properly sized and the price is right and purchase has been from a progressive dealer who should have ability to choose intelligently the source from which he secures his coal, the probability is that the heat value is adequate.

Dustproofing

All domestic stoker coal should be absolutely dustless when delivered and should remain dustless indefinitely. There are several treatments which can be given coal which will make it permanently dustless but of these oil treating is best where the coal is to be used in stokers. If the coal is dustless when delivered it will be quite evident as the air will be entirely free from dust

in suspension. However, this effect may be due to the coal having been wet down with water. After about three days any water which may have been present will have dried out of the surface portions of the pile. Take a few handfuls of this dry surface material and put it in a wide mouthed bottle; shake it well and note in a good light whether dust rises out of the throat of the bottle. If there is dust, of course the coal has not been properly treated; if there is no dust, the test should be repeated and, if after about two weeks there is still no dust, it is safe to assume that the coal will be permanently dustless.

The advantage of oil treatment over other methods of procuring dustlessness is that, while most other dust-laying materials introduce corrosive effects, oil is not only non-corrosive but acts to preserve the metals which the coal contacts. Oil treatment not only makes for cleaner handling by sticking the dust to the larger pieces, but is effective in reducing segregation in the bin, the stoker coal hopper, and the stoker retort. Firing conditions are more regular due to having a more uniform fuel bed and there is less fly ash blown into the heater gas passages. The usual charge for oil treating is 10 cents per ton and it is well worth that and more to the domestic user.

Coking and Caking Characteristics

Few coals cake or soften into sticky masses at ordinary fuel bed temperatures. Should caking occur the fault is probably in the air delivery setting of the stoker. Most stokers are now coming out with automatic air controls, the function of which is to prevent air blasting effects which have made such coals as do have a caking tendency troublesome in the past by allowing excessive air to enter the fuel bed when blow holes develop. Many coals having very high heating effect tend to cake and it is not a fault that is usually difficult to remedy even with stokers having no automatic air control. Caking of coal should not be confused with coking, which is discussed later, or with clinkering of the ash. Most coal dealers can say whether or not the coal they deliver cakes; if it does, stoker air adjustment will usually remedy the difficulty.

Coke is the form that bituminous coal should assume in the stoker fuel bed after the gaseous matter of the coal has been driven off. A proper stoker fuel bed should show a surface composed of coke masses quite uniform in size. Coke which forms low in the stoker retort and builds up as a single mass into a "coke tree" is troublesome. Unless broken up at about 3-hr. intervals these "trees" either continue to rise until they reach the heater crown sheet and apply enough back pressure against the coal feed screw to shear a pin or else fall over and drag the fuel bed out of the active range of the stoker tuyere openings. The "coke tree" phenomenon is most troublesome during mild weather firing. It is characteristic of coals deriving from definite coal producing areas and an experienced coal dealer will know if there is apt to be trouble from this source. As with caking, proper air adjustment will usually remedy the trouble, although not as readily or as effectively. A proper oil treatment helps to reduce "coke tree" difficulty. It is an annoyance rather than a serious fault in coal and is apt to occur in some coals of excellent quality from a heating value standpoint.

Ash Content and Ash Characteristics

It is the materials that compose the ash in coal which have most to do with characterizing it. The ash content of good bituminous coal, the country over, will normally be about 8%. Many coals which go higher in ash are improved when the proportion of fine element is reduced, not because the fine sizes are inherently higher in ash but because in machine mining the undercut is often in slate and the fine cuttings (bug dust) are not properly removed. It is quite unnecessary that this occur and, except that fine coal sizes are hard to clean, there is no real reason why the fine element should be higher in ash than the other sizes.

A few per cent more or less of ash content has almost negligible effect on the heat value of coal but high ash is often indicative of troublesome tendencies.

What is very important in connection with ash is its fusing temperature. It is fusion of ash into clinker which is normally relied upon in underfeed stoker technique for the removal of the incombustible and it is important that the ash fuse into clinker of the right consistency for proper handling. For best results in underfeed stokers the coal ash should fuse at about 2,400F; if it fuses at higher temperature, clinker does not readily form especially during mild weather firing while, fusing below 2,400F, there is a tendency to formation of deep clinkers which obstruct the coal feed screw and of clinkers which run into the tuyere openings and interfere with proper air delivery.

The presence of iron pyrites in stoker coal is indicative of poor preparation. The sulphur of iron pyrites or sulphur in any form does no harm in most stoker coal but iron as a sulphide melts at such a low temperature that it is apt to cause serious trouble. Noticeable iron pyrites normally indicate a poor grade of stoker fuel.

The weight of unfused coal ash is important. It should be neither too light and fluffy nor too heavy. Weight per cubic foot of 12 to 20 lb. is satisfactory.

In general, it can be said that the ash content of coal should be low (1) because high ash emphasizes many stoker troubles and (2) because frequency of manual attention and cost of ash removal are proportional to coal ash content.

Miscellaneous Considerations

It has been stated before that the heat value of coal, given equal ash content, decreases from east to west. This is mainly due to an increasing gradient from east to west in the moisture content within the coal struc-

ture which forms an inherent part of the coal. Completely air dried eastern coal carries about 3% of structural water, coal of the middle states from 9% to 18%, and the far western coal (lignite) from 30% to 40%. This moisture is not only without heat value but some of the useful heat developed in burning the coal must be diverted to drive off this structural water as hot vapor along with the other stack gases.

Nothing has been said about the volatile matter in stoker coal because it is of little importance. Probably best mechanical results are obtained in underfeed stokers with coal over 30% volatile while most of the low volatile coals (18% to 24% volatile) are high in heat value, so, in the light of present knowledge, we might generalize by saying that the lower the volatile the more heat there is available, and the higher the volatile the less mechanical trouble there may be. In passing it should be mentioned that not all the volatile matter contained in coal has heat producing value. From east to west an increasing proportion is inert, a fact which, along with increasing structural water content, accounts for the reduction in heat value from east to west. In eastern coals almost all the volatile matter is actively heat producing while over one fifth of the volatile matter of coals of the middle states is inert as is over a third of the volatile matter in coals of the Pacific slope.

It will be evident from the foregoing discussion of coal characteristics that no concise rule can be laid down for selecting a satisfactory stoker coal. A few broad general rules may be stated, but these should not be accepted too literally. (1) Use screenings with not over 20% smaller size than 10 mesh. (2) Price increments are justified, 40 cents per ton for each 10% reduction in fines below 20%, 50 cents per ton for each additional 1,000 B.t.u. per lb., 10 cents (or somewhat more) for oil treatment which renders coal permanently dustless. (3) Investigate the caking and coking characteristics of the coal and the clinker formation to be expected in the ash, particularly with reference to its fusing point, which should not be far from 2,400F. (4) The area from which the coal comes is valuable information because it is indicative of the probable heat value and the distance the coal is hauled is an important component of its cost at destination. (5) The approximate ash content has considerable bearing while the percent volatile is of no great importance.

Principles of the Heat Pump

AN excellent explanation of the principles underlying the operation of the heat pump is contained in the paper presented by Prof. C. W. Chamberlain of Michigan State College, before the joint session of the ASRE and ASHVE convention last month. The following is abstracted from Professor Chamberlain's explanation of the operation of the heat pump:

In providing water for a certain city, the consulting engineer found an abundant supply 100 ft. below the level of the city. The cost was strikingly reduced by taking advantage of a limited water supply on the slope of a nearby mountain. Springs 1,000 ft. above the level of the city had a capacity of one-tenth the required amount. If the limited supply from the mountain springs had been admitted direct to the city mains the water required to be pumped from the low level wells would have been reduced 10%, but the resulting high pressure would have increased the cost of pumping the remaining 90% from the wells. The cost of plumbing would have been prohibitive and the opening of a tap would have been a serious undertaking. The water from the mountain possessed energy which the consumer was not prepared to utilize. This inconvenient energy might have been removed by any one of a number of devices which would have reduced the pressure, but at the same time would have rendered forever unavailable the valuable energy brought to the city by the mountain water. No engineer should carelessly contribute to the increase of entropy in such an unpardonable manner.

The engineer on this project solved his problem by the simple expedient of passing the mountain water through a turbine which carried a load. The same amount of water was delivered to the city mains but minus its troublesome energy. The load placed on the turbine was the pump delivering the water from the wells below the city. Ten per cent of the city's water supply falling 1,000 ft. pumped 90% from the wells 100 ft. below, with 10% available for loss of efficiency.

If in the above illustration we substitute the term *heat* for the word *water* and *temperature* for the word *pressure* the analogy is scientifically correct. The city to be supplied with water now becomes the interior to be supplied with heat. The unlimited supply of water from the wells below the city becomes the unlimited supply of heat in the outside atmosphere at a temperature below that of the interior. The limited supply of water from the mountain side becomes available electrical supply: "limited" because it costs money, and the amount used should be reduced to the lowest possible minimum. Water can be pumped to a higher level and heat to a higher temperature by the expenditure of energy. It is needlessly wasteful to drop water to a lower level without utilizing its potential energy. It is equally wasteful to increase entropy by frittering "high class" electrical energy down into a lower form, which we call heat, without taking advantage of its ability to pump a larger amount of heat to a higher temperature level.

Papers on Steam Jet Cooling and Metering Feature NDHA Convention

held in Grand Rapids. Discussion on Rates, Corrosion, and Customer Relations also of concern to 170 steam utility engineers attending the 27th annual district heating meeting

"TWENTY years ago the problem of transmitting gas from Texas to Detroit was only of academic interest; today this transmission of gas is just another pipe line.

"At a recent technical meeting in Chicago the statement was made that high-pressure steam can probably be transmitted satisfactorily for two miles. The statement is only important because it calls attention to how little is known about the physical limitations of steam transmission. Economic limitations vary widely with local conditions, but before economic limitations can be computed for all situations, something more must be known about physical limitations.

"Engineers casually thinking about steam transmission problems are prone to limit their thinking to normal pressures of two or three hundred pounds per square inch, dissipate the allowable pressure drop, and arrive at a very narrow distance limit for satisfactory transmission of steam. One of the reports at this convention indicates that the metallurgists are rapidly solving the problem of perfecting materials for safely handling high-pressure steam. Another paper indicates that the chemists are well on their way to solve the water problems for high-pressure boilers.

"With these problems solved a new perspective is in order when distance limits of steam transmission are in question. With initial steam pressures of 1,800 lb. per sq. in. now available, with allowable pressure drops of 1,500 lb. permissible, are the physical limits of transmission two miles, twenty miles, or fifty miles? Such a question sounds rather academic but it is probably less academic than a suggestion to pipe natural gas from Texas to Detroit would have been twenty years ago.

"For those cities located on top of rich coal deposits the transmission of steam fifty or sixty miles may be of only remote interest. For many other cities not so fortunate, but located within fifty or sixty miles of extensive low grade fuel deposits, long distance transmission may be very interesting at a relatively early date."

With these thought-provoking remarks Robert L. Fitzgerald, president of the National District Heating Association, opened the 27th annual convention of that association at Grand Rapids, Mich., June 16. The convention, at which 170 were registered, was one of the most successful ever held by the NDHA and the four days during which the convention lasted were filled with technical sessions, sports, and social events.

Salesmanship

An inspirational talk on salesmanship was a stimulant to the imagination of all those who attended the afternoon session on June 16. Edward Weir, business manager, Grand Rapids Furniture Makers Guild, told his audience that salesmanship was 90% emotional appeal spiked with 10% reason and logic. He teased the audience by saying that there is a million dollar word in salesmanship, a word for which there is no synonym, and one which will open the door to a salesman after the door has been definitely closed by arguments from the prospect to the effect that due to certain conditions the purchase will not be made. This word, he said, was "ordinarily." A salesman can use the argument that *ordinarily* the prospective purchaser's arguments are perfectly valid and that he would accept them without question but that in this particular case ordinary conditions do not hold.

R. J. J. Tennant, The Allegheny County Steam Heating Co., Pittsburgh, presented a report of the sales development committee. In this report V. F. Alley, The Philadelphia Electric Co., spoke on the measure of intangible values of central steam service, following which Mr. Tennant presented a report on fuel price changes and their effect upon steam rates and the sales of steam service, by Henry L. Martin.

Training all employes to be salesmen was the subject capably handled by S. S. Sanford, while J. E. Seiter, Consolidated Gas, Electric Light and Power Co. of Baltimore, gave a progress report on the preparation of a sales manual for district heating utilities.

Commercial Relations

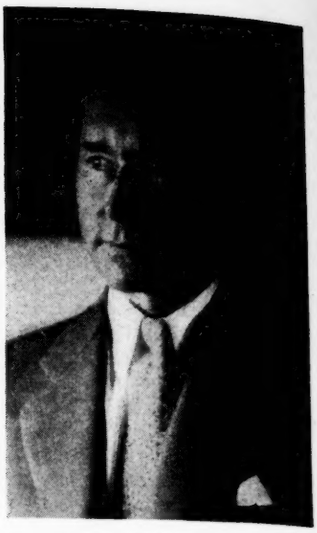
Leonard S. Phillips, New York Steam Corp., and chairman of the commercial relations committee, presented his report which was in four parts, among which was a discussion of the past year's results attained by utilities, including new and projected methods and new theories and applications in the field. A brief time was allotted to the subject of recent developments in heating system controls during which Kirby Walker, American Radiator Co., described his company's model M control.

One of the major points of discussion by Mr. Phillips' committee was that of a paper on a revised issue of "Principles of Economical Heating," which was prepared in considerably enlarged form. This was under discussion at both the afternoon and evening sessions on June 16 and it was finally decided to postpone the publication of this material for a short time until further revision had been made.

New NDHA officers: Melvin D. Engle, president; T. E. Purcell, first vice-president; J. R. McCausland, second vice-president; G. D. Winans, third vice-president; F. L. Witsell, one of the three members of the executive committee. Other members of the executive committee are R. L. Fitzgerald and Edward Lenz.

Landis Shaw Smith, Rochester Gas and Electric Corporation, chairman of the Bulletin publication committee. Mr. Smith is also editor of the Bulletin.

Melvin D. Engle, The Edison Electric Illuminating Company of Boston, NDHA's new president.

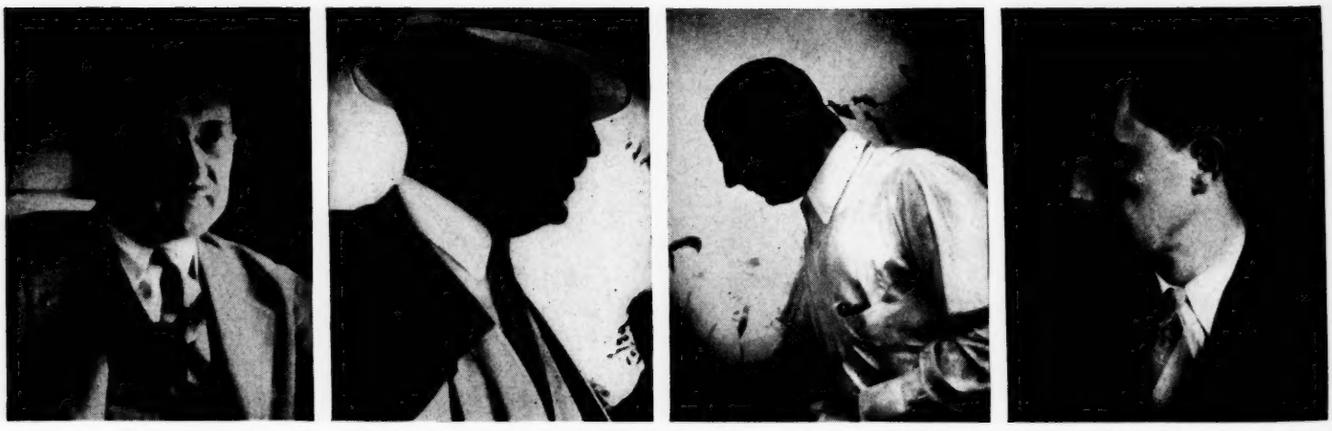


G. K. Saurwein, Harvard University, chairman of the research committee.

At Grand Rapids

Dr. Henry L. Kreisinger addressed the convention on high-pressure power generating cycle and district heating.

R. E. Hall spoke on water conditioning for high-pressure steam generation.



Among the manufacturers represented at the convention were B. M. Conaty, American District Steam Company; Oliver J. Prentice, C. A. Dunham Co.; Warren Webster, Jr.; Kirby Walker, American Radiator Company.

An important part of the report of the meters and accessories committee, of which W. W. Stevenson, Allegheny County Steam Heating Co., is chairman, was the paper by Prof. S. R. Beitler, Ohio State University, on orifice metering. A report on the new isometer flow meter was made by E. A. Lueky, The Detroit Edison Co.

Boiler Plant Practice

From the standpoint of the general heating engineer, possibly the most interesting session of the convention was on Thursday morning at which time reports of the steam heating committee and research committee were given. A. R. Mumford, New York Steam Corp., was chairman of the former and included in his report were discussions on the following: atomizing deaerating boiler feed water heaters, by R. G. Felger; feed water system—Minot St. station, by George C. Eaton; ash cellar ventilation and dirt elimination, by H. J. Bauer; accurate control of water level in feed water heaters, by Howard Goellner; thermocouple system of flue gas temperature measurement, by Thomas Runes; effective parallelling of feed pumps, by A. A. Markson.

Mr. Mumford's report included an address by Henry L. Kreisinger, formerly of the Bureau of Mines and now consulting engineer for Combustion Engineering Corp., who spoke on high-pressure power generating cycle and district heating. He was followed by R. E. Hall, water conditioning engineer, who presented his paper on water conditioning for high-pressure steam generation.

Steam Jet Cooling

G. K. Saurwein, Harvard University, was chairman of the research committee, the report of which was largely devoted to various phases of steam jet cooling. M. A. Nelson, Westinghouse Electric & Mfg. Co., discussed the economic application of steam jet cooling units. Mr. Nelson, in speaking of steam jet cooling units, said: "When using cooling towers, it is not always necessary to design the cooling tower for the worst possible condition of wet bulb temperature known to have existed in the locality in question. Frequently, in order to keep the overall first cost of installation consistent with normal operating conditions, the cooling tower is designed for the normal maximum wet bulb temperature and, on those rare days or hours when this temperature is exceeded, city water is introduced into the condenser circulating system in sufficient quantity to maintain the inlet temperature equal to the normal maximum temperature from the tower. Thus, it is often possible to make material savings in the cooling tower first cost which more than balance the additional operating cost for city water.

"In many cases the discharge water from the condenser of the vacuum cooling unit is not discharged to waste, but is used for building service, such as in a laundry. In case it is expected that there will be building or process users of this water after use in the condenser, it is essential that the manufacturer be informed what maximum discharge water temperature can be used.

"There has been considerable criticism of this form of refrigeration unit because of the large water requirement of the condenser. It will usually be noted in these cases that if the unit was used as originally designed, the water consumption would not be greater than that guaranteed by the manufacturer. If, however, the manufacturer has been misinformed as to the maximum discharge water temperature permissible and the unit is so operated that this water temperature is lower, the increase in water consumption over that guaranteed is not the responsibility of the manufacturer. Again, should the inlet water temperature exceed that given to the manufacturer for his condenser design, resulting in the inability of the vacuum cooler to maintain full load due to decreased condenser vacuum, the responsibility is not the manufacturer's.

"It is sometimes possible to overcome the handicap of excessive condenser water inlet temperature by increasing the amount of water circulated through the condenser when sufficient water can be circulated, so that the discharge water temperature is no higher than would be expected with normal inlet water temperature."

A. A. Markson and R. Menke, both of the New York Steam Corp., prepared a paper on testing of steam jet coolers under artificial loads, in which they described the method of artificially loading a machine in the winter so as to experiment with the steam jet for summer operation, while J. M. Sperzel, engineer of Rockefeller Center, presented a paper relating to the development and application of a control to steam jet refrigeration equipment.

In his conclusion, Mr. Sperzel pointed out that "The absolute evaporator pressure increases rapidly per degree of higher chilled water delivery temperature; the specific volume, or the volume of vapor to be removed per pound of water evaporated, decreases rapidly per degree of higher chilled water delivery temperature; the latent heat per pound of water evaporated, which is removed from the remaining chilled water, decreases very slightly per degree of higher chilled water delivery temperature; the theoretical jet efficiency, expressed in terms of the heat removed per unit volume of vapor removed, increases rapidly per degree of higher chilled water delivery temperature; the theoretical jet efficiency,

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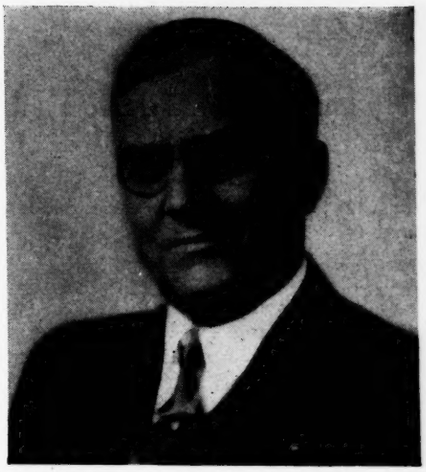

William H. Sanford, newly-appointed secretary-treasurer of the NDHA. His headquarters will be in the Engineers Club Building, 1317 Spruce St., Philadelphia. He was for over 25 years in the office of the chief engineer of the Pennsylvania Railroad. Since 1926 he has been treasurer of the Engineers Club of Philadelphia and since 1934 secretary and treasurer of that group. He succeeds Miss Melissa C. Stocker, who was acting secretary of the association for the past two years.

CONVENTION HEADLINES

CELEBRITIES: Henry L. Kreisinger, internationally prominent authority on boilers and combustion, and R. E. Hall, equally famed as a water treatment engineer.

SPORTS: J. F. Malone, Baltimore, with just enough Irish to demand a hot fight in the discussion Wednesday.

BOOKS: A rival to "Anthony Adverse" appeared at the convention in the form of a pound and a quarter report on rates presented by J. M. Arthur, Jr., of Kansas City.

GOLF: Earle Schultz, Illinois Maintenance Co., Chicago, was awarded the golf cup for his net of 75. C. H. Bay, The Detroit Edison Co., had a low gross of 86.

ASTROLOGY: President Fitzgerald predicted, but cautiously and with reservations, as befits a good engineer, the eventual 50-mile transmission of steam.

MISSING PERSONS: Davis S. Boyden, absent from the convention for the first time in so-many years.

Oil Burner Institute Tackles Local Problems,

sets up regional plan in 10 key markets to aid dealers and manufacturers. Free burner service resolution passed at Minneapolis, first of regional meetings.

LIKE any other, the oil burner industry has its own peculiar headaches. To aid in curing them is one of the reasons for the existence of the Oil Burner Institute, which assists oil burner manufacturers in correcting situations which affect the industry nationally.[1] Of great importance, therefore, is the Institute's committee on legislation, recently engaged in combating the Boland Bill.

Regional chairmen Charles T. Lockwood, Chicago area; C. E. Shields, Bronx-Westchester; C. H. Chalmers, Minneapolis-St. Paul; J. J. Donovan, North Jersey . . . .

This bill, which was pending before the House Ways and Means Committee at Washington, provided for a tax on fuel oil. In view of the narrow cost margin between competitive fuels a tax is of outstanding importance to industries allied with fuels. Congress adjourned, however, without action on this legislation.

Not all of the legislation which can adversely affect the industry is national in scope, however. A similar bill was passed by the Pennsylvania House of Representatives June 1. This bill calls for a ½ cent per gal. tax on fuel oil in the country's greatest anthracite producing state, and presumably was presented on the grounds of fostering one of the state's great industries. The Institute hopes, though, that the Pennsylvania Senate will kill the bill.

In such a business as the manufacture and sale of oil burners, national and state problems are by no means in the majority. Local price cutting and free burner service, especially on the part of the fuel oil dealer and similar strictly local situations tend to cut profits and otherwise discourage the sale of many a burner. An attack on these problems must be carried out in the specific area where the problem exists. For this reason a national organization always has difficulty in dealing with local conditions.

Recognizing this, the Oil Burner Institute has now embarked on a new plan of regional contact to assist local oil burner men dealing with such problems. The plan will be started in the key oil burner markets, and will have as its purpose the maintaining of competitive and profitable markets in those especially important areas.

The plan was announced by G. Harvey Porter, the Institute's Managing Director, in a press meeting, June 3. According to Mr. Porter, no attempt will be made uniformly to organize or regiment the local areas. The only fixed part of the plan in the key market areas is to appoint one member of the Institute for a period of one year as Regional Director. He will be supplied with basic material covering Institute policies and aims, but he will have wide latitude in determining the best means for building cooperation in his district.

In establishing the Regional Plan it is expected that regional meetings will be held in each of the key market centers. To these meetings will be invited local interests in each territory. At these meetings a prepared outline of policies will be uniformly presented and the basis for continuance will be established by each of the groups. Each region will develop methods and problems of its own which will be reported to Institute headquarters by the Regional Director and these will become the basis for suggestions and aid, on the part of the Institute to the industry as a whole.

Ten key market points will be contacted at the outset. These will embrace Boston, Providence, Philadelphia, Baltimore, Detroit, Chicago, Minneapolis-St. Paul. New York will be treated as three separate regions; the first includes Brooklyn and Queens, the second northern New Jersey, with the third made up of the Bronx, Westchester County and Fairfield, Conn. Washington, a key market, will not be organized, inasmuch as competitive conditions there are claimed to be in fine shape, and the Institute intends not to disturb areas where conditions are happy.

Free burner service has been for the past two years not only an irritant but a deterrent in the sale of burners by oil burner dealers and heating contractors who sell burners. Under this plan many fuel oil and oil burner dealers, in some cases backed by the refiners whose oil they sell, retail burners at a low price, relying on their profits from the oil sold to carry their free burner service departments. Other contractors and dealers cannot,

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. . . . Frank H. Dewey, Detroit; F. H. Van Blarcom, Boston; E. P. Bailey, Philadelphia; A. J. Fleischmann, Baltimore area.

[1]The Institute's policies can be summarized as:

1. Study of methods to stimulate the public's acceptance of oil as a fuel;
2. Encouragement of high standards of equipment, manufacture and service;
3. Promotion of uniform and constructive ordinances and legislation affecting oil burning, a program with which the Institute is cooperating with the American Petroleum Industries Committee;
4. Extension of cooperative relationships with the petroleum industries, heating, ventilating and other allied interests, and
5. Use by Institute members of the Institute seal.

GETTING DOWN TO FUNDAMENTALS

14—Estimating Heat Quantities from Electrical Energy

ELECTRICAL energy is now so commonly used that it is rare to encounter a case of heat quantity estimating in which energy in this form is not present. Although there is a direct relationship between electrical energy quantities and heat quantities, the problem of making suitable estimates is not simple, especially where the use of the electrical energy is intermittent, as is so often the case.

The energy in electrical form reappears as heat after being used to accomplish its intended purposes in buildings, and a considerable part of it finds its way into the room air eventually. Commonly, its effect is to add heat to the room air in both winter and summer. In winter the heat from this energy is usually welcome, for it acts to assist the air heating plant. In summer, though, it is generally unwelcome for there is enough heat in the air already and the addition throws more of a burden on the air cooling plant.

We are now concerned especially with estimating for the peak period rather than with general estimates of heat quantities from electrical energy. How can we go about doing this? Before attempting to outline an actual procedure, let us get the general features in mind.

In the first place, it is desirable always to give attention to the point that there are several considerations involved in determining what is to be done about the peak estimate because of the presence of electrical devices or equipment in a building. Keep clearly in mind that simply because the devices or equipment are installed in the building, it does not follow that all, or even any, of them may actually be in operation and giving off heat at the time when peak loads are occurring in either summer or winter. Also, that even though they may be operating, we should ask what assurance there is that they positively will be in operation at the peaks. In other words, we should not only consider the question of what heat quantity *may* be present at the time of the peak, for this gives a quantitative answer, but also we should very carefully consider the degree of certainty of the matter as well.

This brings us to a sound rule of procedure, viz.:

Of all the electrical energy which might affect the peak, consider only that part which can be expected actually and positively to do so.

In other words, do not be generous in making the allowance, but allow only for what can be demonstrated to be necessary. To proceed otherwise is to take an undue amount of capacity from a winter plant and to allow an undue amount of extra capacity in a summer plant for an electrical load which may prove to be non-existent when most needed.

Application of this rule has in the past been carried to the extreme in winter and it has been common practice to make virtually no allowance at all for heat from electrical equipment in sizing the winter plant.

Heat from electrical appliances constitutes a large part of the summer air conditioning load in certain commercial buildings. Methods of estimating these loads are explained in this article, accompanied by the most comprehensive tables showing heat equivalents of energy consumption of electrical equipment ever published. The photograph of the very fine interior shown above, designed by Vahan Hagopian, illustrates the high concentration of heat load in a New York beauty parlor.

Little can be said against such a practice, for in most cases the amount of such heat is but a small fraction of the total requirement. With electrical equipment being used increasingly, however, and especially with the tendency toward greatly increasing the intensity of electric lighting, attention should be given to the question and each case decided on its own particular merits.

In summer, application of the rule first tended to follow the winter practice for the electrical heat load is slight in theater auditoriums which are kept dark so much of the time. With the spread of cooling to beauty shops and restaurants it soon became apparent that something had to be done about the electrical heat load. In summer, however, there is still the urge to make no more allowances than absolutely necessary in order to keep down the first cost of equipment. Now the problem of making suitable allowances is especially acute for cooling installations.

The Real Problem

What must really be determined is the heat quantity from electrical equipment and appliances really operating at the time of the peak, and certain to be so operating, especially in summer, and whose effect is to increase the heat load. With the problem thus narrowed, we are ready to look about for a method and for sources of data to prepare the estimate.

Before we can proceed at all, it is necessary to know the heat quantities which are present, or which may be present when electrical equipment or appliances operate. We can call these quantities the equivalents of the electrical energy put into the devices.

Tables of Heat Equivalents

All electrical equipment, which concerns us here, functions to make energy in electrical form available for use in either mechanical form or as heat energy. Electrical equipment receives electric energy and delivers either mechanical energy or heat energy. The mechanical energy eventually is degraded into heat energy. Consequently, all the electrical energy finally becomes heat energy in some form. The heat quantity arising from supplying a known amount of electrical energy to any appliance or motor is therefore a simple matter to compute. Since B.t.u. per hour is the unit in common use, the heat quantity in terms of this unit can be found by knowing that

(a) 1 watt-hr. = 3.14 B.t.u. per hr.
and (b) 1 hp.-hr. = 2546 B.t.u. per hr.

For many estimating purposes these equivalents are all that are necessary, for the electrical inputs can be found from nameplate ratings. In other cases, however, there are some peculiarities to be taken into account. In either case it is desirable to have available both a statement of principles and a collection of heat equivalents of typical equipment in common use. Several tables have been prepared giving useful rules and heat equivalents for the kinds of electrical equipment commonly met with in preparing heat estimates for our work.

Table 1 includes information necessary to estimate heat quantities arising from electric motors regardless of the equipment they drive or its location relative to the room. In using the table keep in mind that the nameplate rating of electric motors is in terms of the load they can drive (usually in continuous operation) and not in terms of electrical input. If the efficiency of the motor is known, the heat equivalent can be calculated at once by the formula given in the table. Where efficiencies are not known, they can be approximated from the figures given for various motor ratings. Figures are included also to cover the heat quantities involved per horsepower for each of the three possible locations of the motor and its driven device relative to the room being estimated.

In addition to this information covering electric motors in general, Table 2 shows the heat equivalents of some of the more common motor-driven appliances where the motor and its appliances are direct connected. These appliances are made in a great range and variety of sizes. The figures in the table are from the nameplate ratings of a typical manufacturer. They are thus useful in approximating the heat quantities for general estimating purposes, but if greater accuracy is required the actual nameplate rating of the appliance being considered should be secured.

Electrically powered refrigerators are common and in restaurants and drugstores especially such equipment is frequently so located that the heat coming from it may need to be estimated. These refrigerators, being motor driven, follow the general rule for motors given in Table 1. They offer an excellent example of the fact previously mentioned that the location of the motor and the load relative to the room being considered must be taken into account. The table includes two cases commonly occurring. In the one at the left of the table the condenser is air cooled and draws its air from the room and then discharges it back into the room again. The ordinary kitchen electric refrigerator is of this type. Here the figures given are the heat equivalent of the motor input. In the case where only a cold cabinet is located in the room with the compressor and condenser remote, only a small part of the electrical energy of the motor affects the room in which the cabinet is located. In the table this is estimated on the basis of a well insulated cabinet for food preservation. Cabinets for ice cream are usually maintained at a lower temperature and the figures of the table will increase in proportion to the temperature difference between the room and the inside of the cabinet.

In connection with this table it should be particularly noticed too that the figures at the left of the table represent heat being added to the room air throughout the year for the room air acts as a reservoir to catch the energy of the motor, while those at the right represent heat being extracted from the room air throughout the year.

In addition to electric equipment powered by motor there is a great variety of appliances which convert electrical energy into heat without passing it through the mechanical stage. These appliances are used so widely that no attempt is made either to include all their applications or even to list all of them. Table 4 includes many of these appliances used in preparing food and often encountered in restaurants and in home kitchens. As in the other tables, typical appliances have been used to secure the figures and the tables are thus

TABLE 1

Electric Motors

Nameplate Rating of Motor in Horsepower	Average Motor Efficiency in Continuous Operation	B.t.u. per Hr. to Room Air per Rated Hp. of Motor		
		Motor Outside of Room, Driven Device Inside Room	Motor in Room; Driven Device Outside of Room	Motor and Driven Device Both Inside Room
1/8 to 1/2	0.60	2,546	1,700	4,246
1/2 to 3	0.69	2,546	1,100	3,646
3 to 20	0.85	2,546	400	2,946

GENERAL RULE FOR MOTORS: if H_m = B.t.u. per hr. of motor input,

$$H_m = \frac{2{,}546 \times \text{Hp. (connected load)}}{\text{Motor Efficiency}}$$

Note: Where possible obtain actual value of Motor Efficiency. Where not possible: for motors use average efficiencies as listed above; for motor generators use average efficiency for sets up to 3 Hp. as 0.55; for larger sets use average efficiency as 0.80.

TABLE 2

Electric Motor-Driven Appliances

(Motor and Driven Appliance Both in Same Room)

Fans (Blade Diameters, Inches)	B.t.u. per Hr.	Appliances	B.t.u. per Hr.
Ceiling 32	340	Clock	7
52	410	Hair dryer	1,900
56	600	Drink mixer	240
Desk or Wall 8	120	Sewing machine (domestic)	220
10	140	Vacuum cleaner (domestic)	250
12	200	Hair clipper	78
16	300	Vibrator (beauty)	11
Figures are thermal equivalents of nameplate rating, corrected for motor efficiency.		Figures are thermal equivalents of nameplate ratings.	

TABLE 3

Electric Refrigerators

Electric Motor and Air Cooled Condenser in Cabinet in Room Air		COLD CABINET IN ROOM Compressor and Condenser Remote	
Cabinet Volume (Cu. Ft.)	B.t.u. per Hr. (Thermal Equivalent of Motor Input)	With well insulated cabinet in 80F air and 40F inside cabinet allow as follows:	
2-4	530	Cabinet Volume (Cu. Ft.)	B.t.u. per Hr. per Cu. Ft. of Cabinet Volume
5	710	2-4	100 to 75
6-10	850	5-6	70 to 65
12-18	1,060	7-10	60 to 55
		12, 14, 16	55 to 50
		20, 25, 30	50, 45, 40

useful for estimating purposes, but if great accuracy is necessary the wattage input of the particular piece of equipment should be secured and used instead of the table. The appliances used for boiling and heating liquids are listed separately from those used for cooking and baking because when water is boiled a part of the total heat shown in the table may go to add moisture to the room air and would be in the form of latent heat. In the case of cooking and baking appliances, virtually all, if not all, of the applied electrical energy reaches the room air in the form of sensible heat if it reaches the room air at all.

Table 5 similarly gives the heat equivalents of various miscellaneous electrical appliances not used for food preparation but sometimes encountered in rooms for which estimates are being made.

In making estimates electric lighting is probably the most frequently encountered use of electrical energy. Table 6 includes a general statement to cover computation of heat equivalents when wattages are known. When the wattage to be used can actually be determined either from specification or by counting

TABLE 4

Electric Food Preparation Appliances

RESTAURANT APPLIANCES

BOILING AND HEATING LIQUIDS	B.T.U. PER HR.	COOKING AND BAKING	B.T.U. PER HR.
Coffee-maker		Broiler (large, with oven)	61,600
regular burner	6,800	(small, without oven)	27,300
simmer burner	2,060	Griddle (per heater)	10,300
Coffee urn		Hot Plate (simmer)	
1 gal.	3,420	per heater	2,060
2 gal.	3,420	Hot Plate (regular)	
3 gal.	4,100	per heater	6,150
4 gal.	4,100	Ovens, bake	
5 gal.	5,120	10 loaf, per section	10,000
6 gal.	6,000	20 loaf, per section	16,000
8 gal.	7,700	40 loaf, per section	20,500
10 gal.	8,500	60 loaf, per section	31,000
15 gal.	11,000	Ovens, roasting	
20 gal.	14,500	60 lb. type per section	10,000
Water heaters		125 lb. type per section	19,000
4 gal.	6,800	250 lb. type per section	26,000
6 gal.	9,500	Ranges	
8 gal.	12,000	regular burner	6,800
10 gal.	13,700	simmer	2,060
12 gal.	17,000	ovens	10,300
16 gal.	22,200	small burner	4,000
20 gal.	27,200	Ranges, heavy duty	
30 gal.	41,000	3 ft. section—range and oven	40,000
40 gal.	54,500	4 ft. section—range and oven	82,000
Steam table (water pan)	13,700	4 ft. section—cooking top only	62,000
		Steam table (plate warmer)	6,830
		Toaster (240 slices per hr.)	2,060
		Waffle baker (per heater)	3,000

DOMESTIC APPLIANCES

BOILING AND HEATING LIQUIDS		Hot plate (small heater)	1,900
Coffee-maker stove	1,900	(medium heater)	3,400
Coffee percolator set	1,400	Range	
COOKING AND BAKING		small burner	1,800
Sandwich grille	2,000	regular burner	3,500-4,600
Toaster	1,700	giant burner	6,000-7,500
Waffle iron (small)	2,000	range oven	7,000-10,000
Waffle iron (medium)	2,800	warming compartment	1,000

Figures are thermal equivalent of nameplate rating of typical example of appliance listed.

TABLE 5

Miscellaneous Electric Appliances

TYPE OF APPLIANCE	B.T.U. PER HR.	TYPE OF APPLIANCE	B.T.U. PER HR.
Domestic electric irons		Radio (6 to 8 tubes)	340
small	—	Infra red lamp (heat)	850
medium	2,300	Sun lamp	1,350
large	3,400	Neon lights (15 mm), per ft.	12
Tumbler water heaters	1,200	Neon lights (11 mm), per ft.	18
Curling irons	70	Permanent waver (beauty)	4,240

Figures are thermal equivalent of nameplate rating of typical example of appliance listed.

lamps this can be done, but in some cases, especially where an estimate must be prepared before construction, it is necessary to resort to some rule in order to get an estimated wattage. Included in the table is a statement of the watts per square foot of floor area allowed for general lighting for various building types as gathered from several published sources. When more accurate data cannot be secured an idea of the wattages can be obtained from these unit figures.

Using the Tables

Having heat equivalents available we now come to the matter of how to proceed to apply the information in preparing an estimate. Keep in mind the general rule not to allow for any more electrical energy at peak than can actually and positively be expected to be effective at that time.

There are two recognized procedures. One is what might be called a Survey Method and the other a Factor Method.

The survey method consists of actually going to the site, or to the site of an installation similar to the one being considered, and then finding out by any method available just how and at what times the various pieces of electrical equipment actually do operate.

For instance, in a two-meal restaurant, which handles

TABLE 6

Electric Lights

Lamps carry wattage ratings on their surface and can be converted to B.t.u. per hr. by multiplying: wattage × 3.14 = B.t.u. per hr. About 90% of heat equivalent of wattage *may* be carried to room air and affect heat quantity estimates. In some cases, though, not more than 50% of the wattage load in use at peak should be estimated to reach the room air and affect the equipment capacity.

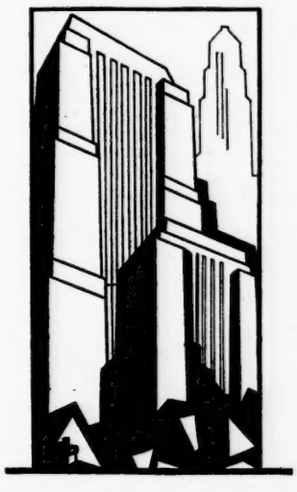
Where count is impossible following data may be used for preliminary estimating of heat equivalent of general lighting:

Place of Installation	B.t.u. per Hr. per Sq. Ft. of Floor Area	Place of Installation	B.t.u. per Hr. per Sq. Ft. of Floor Area
Theater auditoriums	1.5 to 3	Offices	
Church auditoriums	3 to 6	private	6 to 12
Courtrooms	3 to 6	close work	12 to 15
Dental offices	3 to 6	reception	3 to 6
Drafting rooms	6 to 13		
Hospitals		Restaurants	3 to 6
private rooms	3 to 6		
operating tables	65 to 130	Schools	3 to 6
Hotels		Show windows	
lobby	3 to 6	bright	65 to 130
dining rooms	3 to 6	medium	30 to 60
guest rooms	3 to 6	common	20 to 32
Lunchrooms	3 to 6	Stores	6 to 12

a substantially constant volume of business throughout the year, it is not especially difficult to learn, by observation or by questioning or both, what pieces of equipment are in steady operation at various hours of the day. From this it is practicable to build up a list which will show the electrical wattage at each hour of a typical day. When the other heat quantities, such as sun heat, transmitted heat, and others are exmined, together with some thought being given to operating methods and human heat load, a fair idea of the hour at which the peak will occur can be obtained. The electrical load at this hour can be combined with the other heat quantities to produce the combined estimate on which heating and cooling equipment will be sized.

It is evident at once that this method has some serious disadvantages. For one thing an individual estimator will find it laborious and often so time-consuming as to be out of the question. To be used at all it has to be reduced to a form and this information collected at the same time that a survey of the site is being conducted to determine other necessary items of information. Then, too, this method lends itself well only to places already built or for which the floor plan and electrical equipment have been selected. During recent years with modernizing supplying so large a proportion of the available work this method has been used without any great hardship and with alleged good results.

While this method has been thus used for some time and a considerable body of experience data acquired, such data have not been collected or systematized as yet. As a result the survey method is still largely a matter of "finding out" to as good advantage as the exigencies of any particular job will permit. It still requires use of considerable individual judgment in making suitable allowances and cannot be said to be on a satisfactory basis.



The factor method consists essentially of applying to the "connected electrical load" a multiplying factor which will reduce this to the electrical wattage which will occur at the time of the peak operation. The term "connected load" means the sum of the rated wattages.

If a suitable electric meter be connected to the electrical supply going to the building, a reading of the electrical consumption of the whole group of connected equipment during any hour can be obtained. The record of such a meter can be used to determine the electrical consumption at the peak hour of a day or season or for any time period desired. If this electrical consumption for a certain period be divided by the "connected load" the resulting decimal factor is a measure of the diversity of the load. The factor is sometimes called the "diversity factor" of the electrical load.

Evidently the sum of the rated wattages can be obtained from the tables already given in this article. What is necessary to make use of this method, therefore, is a knowledge of the diversity factor for the various kinds of installation and conditions encountered.

As in the case of the survey method, while there is a considerable amount of scattered information in existence containing suitable values of the diversity factor it has not been collected or systematized.

The general conclusion concerning the fundamentals of estimating heat quantities due to electrical equipment, therefore, is that while the quantities themselves can be readily obtained, a suitable procedure for preparing an actual estimate of the quantity at peak is still so lacking in detailed information that there is but little to guide the judgment of the individual estimator.

Research Results and Automatic Controls Feature Warm Air Convention

THE meeting at Columbus, Ohio, June 16-18, of the National Warm Air Heating & Air Conditioning Association drew a large attendance. The program included subjects related to both heating and cooling, and was featured by papers on automatic control and on studies made in the Research Residence which the association maintains at Urbana, Ill.

Many of those in attendance took advantage of the invitation of Battelle Memorial Institute to visit the research laboratories where the research being conducted for the bituminous coal industry attracted much attention. A luncheon and entertainment and golf at the Columbus Country Club made up the social side of the meeting.

President Rybolt drew attention to the necessity of maintaining sound engineering practice and the use of quality goods only if warm air heating is to continue to hold a favorable position. Merchandising came in for attention from R. D. Marshall, Williams Oil-O-Matic Corp., while H. S. Sharp, Henry Foundry & Furnace Co., spoke on the necessity of operating profitably. Other speakers from the industry included H. R. Jones, Lamneck Products, Inc., and E. B. Lau, Lau Heating Service, Inc.

One of the projects which has long occupied a prominent place among the activities of the association has been the development and continuous revision of installation codes. Prof. J. D. Hoffman, Purdue University, presented to the convention the latest revision of an installation code for mechanical furnace plants, and advised that it is expected that this code will be ready for distribution in the early fall.

G. D. Kingsland, Minneapolis-Honeywell Regulator Co., used the subject of zone control as the basis for his paper, and explained both the importance of suitable zoning and outlined methods for accomplishing zoning.

Burton E. Shaw, Penn Electric Switch Co., presented a paper resulting from a study made in a residence in Des Moines fired by a stoker under automatic control. Mr. Shaw's data included information on the effects of the cycling period, and of especial interest were curves showing the apparent relation between the variation of fuel consumption from normal with variations in wind velocity and solar radiation. The field study did not show any relation between inside and outside relative humidities and fuel consumption. Mr. Shaw's data also brought out clearly the variation in fuel consumption with adjustment of the air supply to the stoker, showing the importance of having the air supply to the stoker under control if maximum fuel economy is to be obtained.

As has been true in recent years, papers resulting from work done at the Research Residence of the association made up a very considerable part of the program. Prof. M. K. Fahnestock reviewed the research work in summer cooling which has been done at the residence, while Prof. A. P. Kratz reviewed the work done on forced air heating. S. Konzo presented data resulting from operating an oil-burning furnace in the residence.

Professor Fahnestock mentioned that since the summer cooling at the Research Residence was started in 1932, three different cooling plants have been installed and operated at one time or another. These plants have used ice, mechanical refrigeration, and water from city mains to accomplish the cooling. Surface cooling coils located in the central duct have been used as the means of lowering the air temperature throughout all the studies. First- and second-story windows have been kept closed throughout the tests, but attic windows were open when cooling was done with mechanical refrigeration and with water from city mains. In the majority of the studies the house has been equipped with awnings on the windows, although a few tests were made with the awnings removed.

Earlier studies on the residence made use of ice for cooling, following which the operation of the plant using mechanical refrigeration was studied. The most recent studies have been conducted with water from the city mains. Professor Fahnestock especially noted in his paper that comparisons of the operating results obtained during the several summer seasons which have been studied should not be made unless suitable corrections are applied to the data. These corrections are difficult and superficial comparisons are likely to be extremely misleading.

Professor Fahnestock also called attention to the fact that the test data obtained on the research residence would indicate that at present it is futile to attempt to predict or estimate the severity of any approaching summer season from a knowledge of the preceding ones. At Urbana, during the 12-year period, 1923-35, the mean number of degree-hours per season was 1,350, but the minimum during one of these seasons was 360 degree-hours, while the maximum was 2,660 degree-hours. This would indicate a fluctuation of 750% between the mildest and severest season and a variation from the mean of as much as 350%. Attention was further drawn to the fact that actually during any of the seasons the residence was not cooled by any one method, as trials and experiments to find the effect of certain variables were continually going on.

During 1935 the mild summer made it possible to supplement artificial cooling from the city mains with the circulation of outdoor air at night.

It is planned to continue the studies at the Research Residence during the present summer, using water as the cooling medium at temperatures from 52F and 45F.

Papers on Steam Jet Cooling and Metering Feature NDHA Convention

(Concluded from page 37)

expressed as an accumulative percentage increase in B.t.u. per cubic foot removed per degree Fahrenheit above 46F, increases very rapidly per degree of higher chilled water delivery temperature."

The concluding paper of this committee's report was that of Claude R. Erickson, Board of Water and Electric Light Commissioners, Lansing, Mich., on the friction effect of slip joints, rollers, and guides on long steam transmission mains. According to the author, in a steam transmission or distribution main, the resistance offered by well designed and maintained slip joints, rollers, and guides has no effect on the elongation of the line due to an increase in temperature. The elongation of the pipe line, therefore, may be accurately computed as pure linear expansion. If the actual elongation of the pipe as measured at the slip joint is less than the computed elongation it may be attributed to one of the following reasons: the use of an incorrect coefficient for the pipe material under consideration; movement of the anchor supports; transverse deformation of the pipe.

Air Conditioning Manufacturers Adopt Application Engineering Standards

presented here in full. Code relates to air conditioning for comfort.

APPLICATION engineering standards for comfort air conditioning were adopted by the Air Conditioning Manufacturers' Association at its annual meeting at Hot Springs, Va., May 16. The standards were released for publication June 12 and are presented here in full.

In making the release, ACMA draws attention to the fact that these standards are actually "recommended practice" for ACMA members, pending the formulation of an adequate national standard for air conditioning application under the sponsorship of technical societies. Also it is expected that there will be some further minor modifications during the next month or so in these standards. The code follows:

A. Scope and Purpose

This code is limited to application engineering standards and practices for determining the conditions and the loads for which to design systems for conditioning air for the comfort of persons, for installation within the United States.

These are minimum standards and are to be construed as defining recommended practice, rather than as hindering progress, or as preventing the use of other standards where such are justified by the economies of a case and where departures below good practice minimums are made clear to the buyer.

B. Name

The name "Air Conditioner" or "Air Conditioning" shall not be applied to any air treating combination which is not designed to embody the minimum complement of functions as defined below in paragraph C. If a system embodies less, it shall be called by a name which describes only the functions performed, and does not incorporate the words "Air Conditioning" or "Air Conditioner."

C. Definitions

Application engineering standards for air conditioning are those relating to conditions and factors which form the basis of design load estimating and specifications of performance. These are distinguished from standards of apparatus design, of installation practices, of trade practices and of safety.

The design load is the capacity required of the apparatus to maintain specified conditions inside when specified extreme conditions of temperature and humidity obtain outside and when all sources of load are taken at the maximum that will occur coincidentally, during periods of outside extremes.

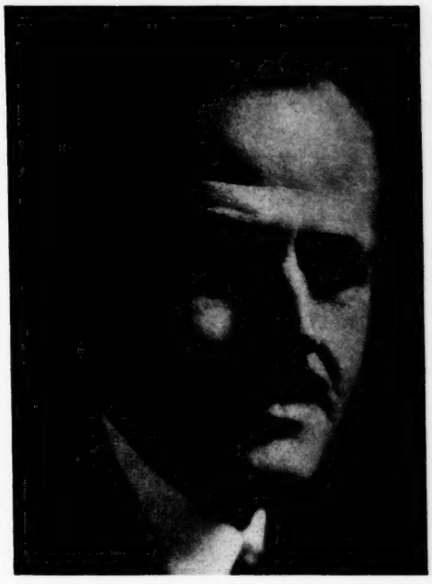
Design inside conditions are the dry and wet bulb temperatures (or relative humidity) specified to be maintained inside at the time of occurrence of the design load.

Design outside conditions are the dry and wet bulb temperatures (or relative humidity) specified for design load computation.

Comfort air conditioning provides ventilation, air circulation, air cleaning and maintains temperature and humidity for the comfort of people.*

An air conditioning system provides ventilation, air circulation, air cleaning and equipment for maintaining temperature and humidity within prescribed limits.*

*Taken from ASRE code for rating and testing air conditioning equipment.



Donald French,

Carrier Engineering Corp., chairman of the ACMA technical and code committee responsible for the application engineering standards. Other members of the committee are: F. H. Faust, General Electric; Elliott Harrington, General Electric; A. F. Karlson, Parks-Cramer Co.; C. E. Lewis, Delco-Frigidaire Conditioning Corp.; A. J. Mallinckrodt, Baker Ice Machine Co., Inc.; L. S. Morse, York Ice Machinery Corp.; Dr. L. A. Philipp, Kelvinator Corp.; R. E. Robillard, Frigidaire Corp.; Harry Sloan, Vilter Mfg. Co.; R. M. Stikeleather, B. F. Sturtevant Co.; E. R. Wolfert, Westinghouse Electric & Mfg. Co.; Dr. J. R. Zwickl, De La Vergne Engine Co.

An air conditioner is a specific combination consisting of means for ventilation, air circulation, air cleaning and heat transfer with control means for maintaining temperature and humidity within prescribed limits.*

A cooling (summer) air conditioner is a specific air treating combination consisting of means for ventilation, air circulation, air cleaning, cooling and dehumidifying with control means for maintaining room temperature and humidity within prescribed limits.*

A heating (winter) air conditioner is a specific air treating combination consisting of means for ventilation, air circulation, air cleaning, heating and humidifying with control means for maintaining room temperature and humidity within prescribed limits.*

D. Design Load Factors

The following shall be specified as a basis for the calculation of design loads: design inside conditions, design outside conditions, number of occupants and other sources of substantial load from within doors, c.f.m. per person assumed for ventilation, time of day at which maximum load is estimated to occur, and class of activity assumed for occupants.

Calculations of design loads shall include the following sources of heat loss and heat gain: *Heat loss* (winter load): Conduction through physical barriers, such as walls, doors, windows, floors, ceilings, etc., and heat and moisture required for incoming outdoor air. *Heat gain* (summer load): Conduction through physical barriers, such as walls, doors, windows, floors, ceilings, etc.; heat from sunshine, direct effect through glass areas exposed to the sun and additional conduction through opaque barriers, such as walls, roofs, etc., exposed to the sun; heat and moisture introduced by incoming outdoor air; heat and moisture liberated by occupants; and heat and moisture liberated by appliances, illumination, combustion, etc.

The basis of all these design load values shall conform with the data in the current issue of the ASHVE Guide except where these standards give other specific requirements.

E. Design Outside Conditions

Heating: The design outside dry bulb temperature for calculating heating load shall be that minimum temperature which has been recorded on more than 2% of the days when heating is required. The local weather

TABLE 1.—INSIDE DESIGN CONDITIONS FOR COMFORT COOLING

Outside Design Dry Bulb	Class AA Special Application Occupancy Over 40 Min.			Class A Average Application Occupancy Over 40 Min.			Class B Occupancy Under 40 Min.		
	Dry Bulb	Wet Bulb	R.H. %	Dry Bulb	Wet Bulb	R.H. %	Dry Bulb	Wet Bulb	R.H. %
85	73	64	64	74	64	60	75	64	57
	74	62	53	75	62	50	76	63	48
	75	61	45	76	61	43	77	61	41
	76	59	38	77	59	35	78	59	32
90	75	66	65	77	67	62	78	68	60
	76	65	57	78	66	53	79	66	53
	77	63	48	79	65	48	80	65	45
	78	62	41	80	63	40	81	64	40
95	77	67	60	79	68	58	81	69	55
	78	66	54	80	67	51	82	68	49
	79	65	47	81	66	45	83	67	44
	80	64	42	82	65	40	84	66	38
100	78	69	65	80	69	58	82	70	57
	79	68	57	81	68	52	83	69	51
	80	66	50	82	66	44	84	68	45
	81	65	43	83	65	38	85	67	38
105	79	69	63	81	70	58	83	71	57
	80	68	57	82	68	51	84	70	50
	81	67	49	83	67	45	85	69	45
	82	66	43	84	66	39	86	68	40

NOTE: It is recognized that in certain unusual localities, the outside design dewpoint is substantially less than the dewpoint of the tabulated inside design conditions. In such cases, the code committee will entertain the recommendations by local authorities of the inside design conditions for use in those localities.

TABLE 2.—DOOR INFILTRATION IN SUMMER COMMERCIAL ESTABLISHMENTS—REVOLVING AND SWINGING DOORS OPENING TO OUTSIDE

Application	Infiltration C.F.M. per Person in Room	
	72-In. Revolving Door	36-In. Swinging Door
Bank	6.5	8.0
Barber shop	4.0	5.0
Broker's office	5.5	7.0
Candy and soda	5.5	7.0
Cigar store	20.0	30.0
Department store (small)	6.5	8.0
Dress shop	2.0	2.5
Drug store	5.5	7.0
Furrier	2.0	2.5
Hospital room	—	3.5
Lunch room	4.0	5.0
Men's shop	2.7	3.7
Office (private)	—	2.5
Office (professional)	—	3.5
Restaurant	2.0	2.5
Shoe store	2.7	3.5
When Doors Are Left Open Continuously		
72-in. revolving door (panels open)	1200 c.f.m.	
36-in. swinging door (standing open)	800 c.f.m.	

NOTE: These values for swinging doors and for doors left open hold only where such doors are in one wall only, or where the doors in other walls are of the revolving type. If swinging doors are used for access, or doors are left open, in more than one wall, the infiltration cannot be estimated. The values for revolving doors hold regardless of number or location.

To determine the total c.f.m. infiltration due to opening of doors, multiply the design number of occupants by the factor from the above table for the kind of establishment in question. When there is more than one door, treat them as though there were only one, except in case of open doors.

TABLE 3.—AVERAGE TEMPERATURE DIFFERENCE, AIR CURRENTS IN OCCUPIED SPACES

Air Current Velocity Lin. Ft. per Min.	Temperature Difference Average F Minus Current F
40 and over	2
Less than 40	3

bureau information for the past 10 years shall be used as the authority for this record. For the purpose of this code, it is assumed that heating is required on any or all days when the average daily temperature is 65F or less. For convenience, Table 4 gives approved temperatures to be used when local data are not available.

Cooling: The design outside conditions for cooling shall be the average for ten years of the highest dry and wet bulb temperatures remaining each year after excluding those higher temperatures which have occurred on only ten days of each year and for durations of less than three hours.

Figs. 1 and 2 show maps of the United States, giving approximate design dry bulb and wet bulb temperatures which are approved for use until additional data are available. If the application of the above formula to authoritative weather records for an individual locality determines outside design conditions which differ from those given by the map, they will be approved instead.

These design outside conditions are considered to occur at 3 p.m.

F. Design Inside Conditions

Heating: The design inside dry bulb temperature shall be 70F. The design inside relative humidity shall be 35% with an outside temperature of 30F.

Cooling: The design inside temperature and humidity shall be not more than that shown in Table 1.

G. Heat from Sunshine

(Basis of determination to be added later)

H. Design Outside Air Quantity

The total quantity of outside air used as a basis for design load calculations shall be the infiltration, or the air required for ventilation, whichever is greater. These shall be determined as outlined in paragraphs I and J below.

I. Infiltration

Heating: Infiltration rates for calculating heating loads shall be determined in accordance with the latest edition of the ASHVE Guide.

Cooling: Infiltration rates for calculating summer cooling loads shall not be less than those indicated in Tables 2 and 7.

J. Ventilation Requirements

In no case shall ventilation be less than that required by any local ordinance. For summer cooling, the ventilation per stated occupant shall be not less than that shown in Table 5.

K. Design Occupancy

The design load calculations shall be based on the stated occupancy of the building during the time of maximum design conditions. The heat given off by each occupant shall be calculated as not less than that in Table 6.

TABLE 4.—OUTSIDE AIR CONDITIONS FOR HEATING ESTIMATES

The following table lists the recommended outdoor winter temperatures to use as the basis for preparing heating estimates. These figures should be used unless the customer specifies the temperature upon which the estimate shall be made.

The figures given in this table are not the extreme minimum temperatures recorded in each locality and it is to be expected that lower temperatures will be encountered. However, very low temperatures usually exist only for short periods. It is thus unnecessary and uneconomical to design the heating system for the extreme minimum temperature.

State and City	Design Temp. F
ALABAMA	
Anniston	5
Birmingham	5
Gadsden	0
Mobile	15
Montgomery	10
Tuscaloosa	5
ARIZONA	
Bisbee	15
Flagstaff	—15
Globe	20
Nogales	20
Phoenix	25
Tucson	20
Yuma	20
ARKANSAS	
Fort Smith	10
Hot Springs	5
Little Rock	5
Pine Bluff	10
Texarkana	10
CALIFORNIA	
Bakersfield	15
Fresno	25
Los Angeles	30
Montague	0
Pasadena	25
Sacramento	25
San Diego	35
San Francisco	35
San Jose	20
COLORADO	
Boulder	—15
Colorado Springs	—25
Denver	—20
Fort Collins	—30
Grand Junction	—15
Pueblo	—25
CONNECTICUT	
Bridgeport	—5
Hartford	—5
New Haven	—5
New London	—5
Norwalk	—5
Torrington	—10
Waterbury	—15
DELAWARE	
Dover	5
Milford	5
Wilmington	5
DIS. OF COLUMBIA	
Washington	0
FLORIDA	
Fort Myers	35
Gainesville	20
Jacksonville	25
Key West	45
Miami	35
Orlando	35
Pensacola	20
Tallahassee	25
Tampa	35
GEORGIA	
Athens	10
Atlanta	10
Augusta	15
Columbus	10
Macon	15
Rome	10
Savannah	15
Way Cross	20
IDAHO	
Boise	0
Lewiston	5
Pocatello	—5
Twin Falls	—10
ILLINOIS	
Aurora	—10
Bloomington	—10
Chicago	—10
Danville	—5
Decatur	—10
Elgin	—10
Joliet	—10
Peoria	—10
Rockford	—10
Springfield	—10
INDIANA	
Elkhart	—5
Evansville	0
Fort Wayne	—10
Indianapolis	—5
South Bend	—5
Terre Haute	—5
IOWA	
Burlington	—10
Cedar Rapids	—5
Clinton	—10
Council Bluffs	—10
Davenport	—10
Des Moines	—15
Dubuque	—10
Fort Dodge	—20
Keokuk	—10
Marshalltown	—15
Sioux City	—20
Waterloo	—15
KANSAS	
Atchison	—10
Concordia	—10
Dodge City	—10
Leavenworth	—10
Salina	—15
Topeka	—10
Wichita	—5
KENTUCKY	
Bowling Green	0
Frankfort	0
Hopkinsville	0
Lexington	0
Louisville	0
Owensboro	0
LOUISIANA	
Alexandra	20
Baton Rouge	20
New Orleans	25
Shreveport	15
MAINE	
Bar Harbor	—15
Belfast	—5
Eastport	—10
Lewiston	—15
Millinocket	—15
Orono	—20
Portland	—10
Rumford	—20
MASSACHUSETTS	
Amherst	—10
Boston	0
Clinton	—10
Concord	—15
Rall River	—10
Fitchburg	—10
Lawrence	—10
Lowell	—15
New Bedford	0
Pittsfield	—10
Plymouth	—5
Springfield	—10
Worcester	—10
Framingham	—10
MARYLAND	
Annapolis	5
Baltimore	5
Cambridge	5
Frederick	—5
Frostburg	—5
Salisbury	10
MICHIGAN	
Alpena	—10
Ann Arbor	—5
Big Rapids	—15
Calumet	—15
Detroit	0
Flint	—10
Escanaba	—15
Grand Rapids	—10
Kalamazoo	—5
Lansing	—10
Ludington	—10
Marquette	—10
Muskegon	0
Port Huron	—5
Saginaw	—10
Sault Ste. Marie	—20
MINNESOTA	
Alexandria	—25
Duluth	—25
Minneapolis	—20
St. Cloud	—25
St. Paul	—20
MISSISSIPPI	
Biloxi	15
Columbus	15
Hattiesburg	15
Jackson	15
Meridian	10
Natchez	15
Vicksburg	15
MISSOURI	
Columbia	—10
Hannibal	—10
Kansas City	—5
St. Louis	—5
St. Joseph	—10
Springfield	—10
MONTANA	
Anaconda	—15
Billings	—25
Butte	—20
Great Falls	—20
Havre	—30
Helena	—25
Miles City	—35
Missoula	—20
NEBRASKA	
Grand Island	—20
Hastings	—25
Lincoln	—10
Norfolk	—15
North Platte	—20
Omaha	—10
York	—15
NEVADA	
Las Vegas	20
Reno	—5
Tonopah	5
Winnemucca	—15
NEW HAMPSHIRE	
Berlin	—25
Claremont	5
Concord	—20
Franklin	—15
Hanover	—20
Keene	—20
Nashua	—15
NEW JERSEY	
Asbury Park	5
Atlantic City	10
Bayonne	5
Belvidere	—10
Bridgeton	5
Dover	0
Elizabeth	0
Englewood	—5
Jersey City	5
Lambertville	—5
Long Branch	5
Newark	5
New Brunswick	0
Paterson	—5
Phillipsburg	—5
Plainfield	—5
Somerville	—5
South Orange	—5
Trenton	5
NEW MEXICO	
Albuquerque	5
Raton	—5
Roswell	—10
Santa Fe	0
NEW YORK	
Albany	—5
Auburn	—5
Binghamton	—10
Buffalo	—5
Cortland	—10
Elmira	0
Glens Falls	—15
Ithaca	—15
Jamestown	—10
Lake Placid	—20
Little Falls	—20
Lockport	—5
New York City	0
Norwich	—15
Ogdensburg	—20
Oneonta	—15
Oswego	—10
Port Jervis	—5
Rochester	—5
Syracuse	—15
Watertown	—15
NORTH CAROLINA	
Asheville	5
Charlotte	10
Greensboro	15
Newbern	20
Raleigh	15
Salisbury	10
Wilmington	20
Winston-Salem	10
NORTH DAKOTA	
Bismarck	—30
Devils Lake	—30
Grand Forks	—25
Jamestown	—25
Minot	—30
Williston	—35
OHIO	
Akron	—5
Cincinnati	—5
Cleveland	—5
Columbus	—10
Dayton	—10
Ironton	0
Lancaster	—5
Lima	—5
Marion	—10
Sandusky	0
Toledo	—5
Warren	—10
OKLAHOMA	
Ardmore	10
Bartlesville	—10
Guthrie	—5
Muskogee	0
Oklahoma City	—5
Tulsa	—5
OREGON	
Baker	0
Eugene	15
Pendleton	—15
Portland	15
Salem	15
Wamic	0
PENNSYLVANIA	
Altoona	—5
Bethlehem	—5
Clearfield	—10
Coatesville	—5
Erie	0
Franklin	—15
Harrisburg	5
Lancaster	—5
Lebanon	—5
New Castle	0
Philadelphia	5
Pittsburgh	—5
Reading	—5
Scranton	—10
Warren	—15
Williamsport	—5
York	—5
RHODE ISLAND	
Bristol	0
Providence	0
SOUTH CAROLINA	
Charleston	20
Columbia	15
Florence	20
Greenville	15
Spartanburg	15
SOUTH DAKOTA	
Aberdeen	—30
Huron	—20
Rapid City	—20
Sioux Falls	—20
Watertown	—20
TENNESSEE	
Chattanooga	15
Jackson	10
Johnson City	0
Knoxville	10
Memphis	5
Nashville	5
TEXAS	
Abilene	15
Amarillo	—5
Austin	10
Brownsville	30
Corpus Christi	20
Dallas	10
Del Rio	15
El Paso	10
Fort Worth	10
Galveston	25
Houston	25
Palestine	15
Port Arthur	10
San Antonio	20
Waco	20
UTAH	
Logan	—15
Ogden	—10
Salt Lake City	—5
VERMONT	
Bennington	—10
Burlington	—10
Newport	—15
Rutland	—20
VIRGINIA	
Charlottesville	10
Danville	10
Lynchburg	10
Norfolk	15
Petersburg	10
Richmond	10
Roanoke	5
WASHINGTON	
Aberdeen	10
Bellingham	10
Everett	10
Olympia	10
Seattle	10
Spokane	—10
Tacoma	10
Walla Walla	—10
WEST VIRGINIA	
Bluefield	—10
Charleston	0
Elkins	—10
Fairmont	—10
Huntington	—5
Martinsburg	—5
Parkersburg	—10
Wheeling	—5
WISCONSIN	
Ashland	—20
Beloit	—10
Eau Claire	—20
Green Bay	—20
La Crosse	—25
Madison	—10
Milwaukee	—10
Oshkosh	—15
Sheboygan	—10
WYOMING	
Casper	—20
Cheyenne	—20
Sheridan	—30

L. Heat from Appliances

(A table is to be included later)

M. Transmission Coefficients

Heat conduction shall be based on transmission coefficient for physical barriers such as walls, doors, windows, ceilings, floors, etc., as given by the 1932 edition of ASHVE Guide.

N. Total Air Circulation

The total air circulation is not specified. It shall be determined by the heating and cooling load and the type and arrangement of supply openings. It shall be adequate to meet the requirements under O.

O. Air Distribution

The quantity and temperature of the treated air and the method of introducing it to the conditioned space shall be designed to limit, to 3F or less, the variation in dry bulb temperature at the same level throughout that portion of a single room that is normally frequented by persons.

It is desirable to avoid air velocities exceeding 50 lin. ft. per min. in the zone between the floor and the 5-ft. level, in spaces normally frequented by persons who are not normally moving about.

Exception must be made of the vicinity of a supply or return grille when construction necessity requires it to be located below the 5-ft. level and in a space normally frequented by occupants.

For cooling, it is desirable that the difference between the temperature of air currents in the space frequented by occupants and the average temperature in such space be not greater than is shown in Table 3 for the various air current velocities.

P. Duct Capacity

It is desirable that return ducts be sized large enough to handle 100% of the circulated air to permit economical heating and cooling prior to occupancy. It is desirable that the outside air duct be large enough to handle 100% of the total circulated air to permit economical operation during mild weather, but in every case it shall be large enough to admit 50% more air than that determined from the preferred values in Table 5.

TABLE 5.—VENTILATION STANDARDS

Application	C.F.M. per Person	
	Preferred*	Minimum*
Apartment†	15	10
Banking space	10	7½
Barber shop	10	7½
Beauty parlor	10	7½
Broker's board room	30	20
Cocktail bar	20	15
Department store	7½	5
Directors' room	30	30
Funeral parlor	10	5
Hospital room†	15	10
Hotel room	15	10
Office, general	15	10
Office, private†	30	15
Restaurant	15	12
Shop, retail	10	7½
Theater	7½	5
Note: For General Application		
Each person, not smoking	7½	5
Each person, smoking	30	25

†Figure at least one person for each 50 ft. of floor area, but do not pyramid such loads for multiple rooms beyond the maximum simultaneous peak.
*Whether the preferred or minimum values are used, the outside air ducts shall be sized to admit at least 50% more than the preferred values.

TABLE 6.—HEAT OF PERSONS—B.T.U. PER HR.

Design Room Temp.	Activity Class A per Person Sitting or Moving Slowly			Activity Class B per Person Working or Dancing		
	Sensible Heat B.T.U. per Hr.	Latent Heat B.T.U. per Hr.	Total Heat B.T.U. per Hr.	Sensible Heat B.T.U. per Hr.	Latent Heat B.T.U. per Hr.	Total Heat B.T.U. per Hr.
84	180	220	400	150	510	660
82	200	200	400	180	480	660
80	220	180	400	210	450	660
78	240	160	400	240	420	660
76	256	144	400	270	390	660

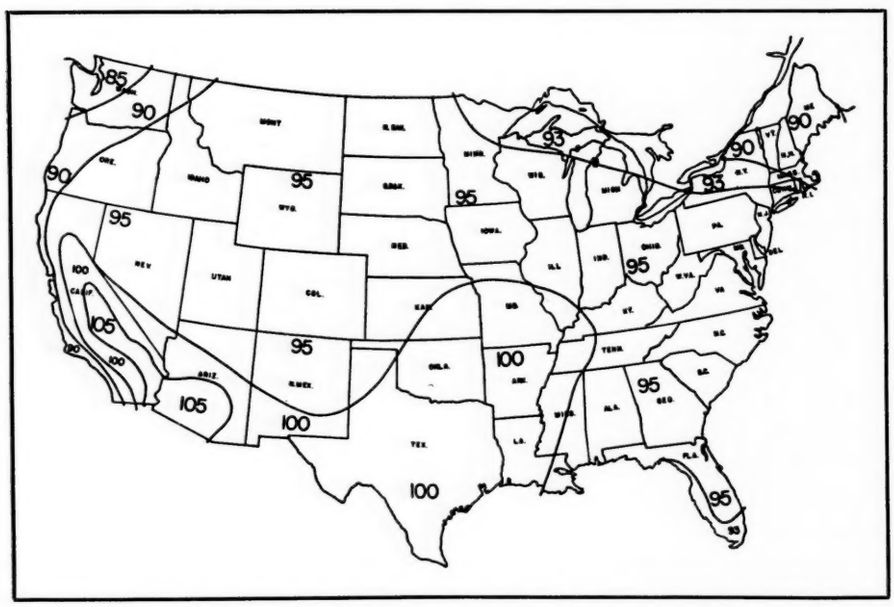


Fig. 1. Outside design dry bulb temperatures in U. S., for cooling estimates

Q. Capacity Specifications

The air conditioning equipment shall have a capacity equal to the design load defined in paragraph D under the following conditions:

Cooling: Design outside conditions defined in Sec. E (Cooling); design inside conditions defined in Sec. F (Cooling); design air quantity defined in Sec. G; and design occupancy defined in Sec. J.

Condensing medium for refrigeration equipment:

(1) Water cooled refrigeration equipment—(a) City water temperature not less than the average maximum value for the months of July and August. (ASHVE Guide); (b) Well water temperature not less than the average maximum value for the months of July and August; (c) Cooling Tower—The tower shall deliver water not more than 10F above the design wet bulb temperature.

(2) Air cooled refrigeration equipment. The condenser air tem-

TABLE 7.—INFILTRATION THROUGH CRACKS AROUND WINDOWS

Type of Window	Remarks	C.F.M. per Ft. of Crack —Wind Vel. 10 M.P.H.		C.F.M. per Sq. Ft. of Entire Sash Area— Wind Vel. 10 M.P.H.	
		Single Window	Double Window or Storm Sash	Single Windows	
				Small	Large
Double hung wood sash windows (unlocked)	Average window not weatherstripped	0.36	0.28	0.46	0.29
	Average window weatherstripped	0.27	0.20	0.34	0.22
	Poorly fitted window not weatherstripped.	1.16	0.85	1.50	0.93
	Poorly fitted window weatherstripped.....	0.33	0.27	0.42	0.27
Double hung metal windows	Non-weatherstripped (unlocked)	0.78	0.60	1.00	0.62
	Weatherstripped (unlocked)	0.33	0.27	0.42	0.27
Single sash metal windows	Hollow metal (vertically pivoted)	1.75	1.48	—	—
	Residential casement	0.55	0.40	—	—

Infiltration through door cracks may be assumed to be twice that of window cracks. Small windows are approximately 30 in. x 72 in.; large windows are approximately 54 in. x 96 in.

perature shall be not less than the design dry bulb. Allowance should be made for temperature rise above ambient for an air cooled condensing unit installed in a room, its amount depending on the unit size, room volume and rate of ventilation.

(3) Refrigeration equipment with Evaporative Condenser cooling. The condenser shall be selected for a wet bulb temperature not less than the design wet bulb. Allowance should be made for temperature rise above ambient for an Evaporative Condenser installed in a room, its amount depending on the unit size, room volume and rate of ventilation.

Heating: Design outside conditions as defined in Sec. E (Heating); design inside conditions as defined in Sec. F (Heating); design outside air quantity as defined in Sec. H (Heating); and heating medium at a temperature that can be maintained by the heat generating device when delivering heat to the heating device at a rate not less than the design heating load.

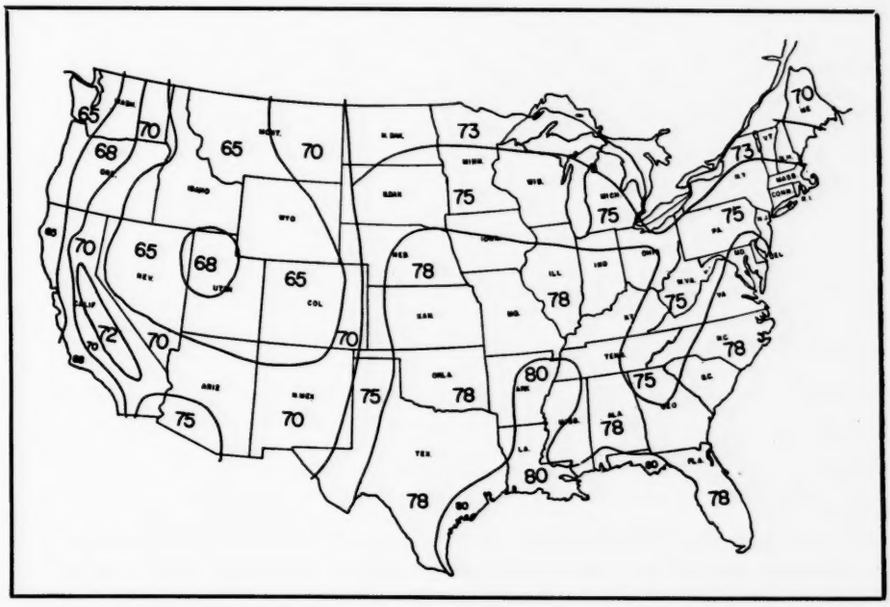


Fig. 2. Outside design wet bulb temperatures in U. S., for cooling estimates

R. Noise

The sound level meter specified by the American Standards Association's Committee on Sound, shall be used for noise readings. Noise values to be given in terms of db. based on the 40 db. weighted network. Where noise specifications are made they shall specify the room noise level due to the operation of the apparatus corrected to the noise level of the room when the apparatus is not in operation.

Noise readings in the conditioned space shall be taken—(a) In the case of apparatus located within the room, at a height of 5 ft. and at a distance of 5 ft. from the apparatus; (b) In the case of air inlet or outlet openings, at a height of 5 ft. and in front of the opening at a horizontal distance of 5 ft. from wall in which opening is located.

Oil Burner Institute Tackles Local Problems

(Concluded from page 38)

in most cases, meet such competition. They make but small profit on the sale of a burner which is not enough to allow for servicing of the burner.

While Oil Burner Institute members will be the Regional Directors during the organizing of their regions, the meeting will be called not only for Institute members but for all oil burner manufacturers, dealers, and others interested in the sale of oil burners in the region. Regional Chairmen on opening the meetings will explain the major policies of the Institute, then a resolution on the elimination of free burner service will be presented, and after discussion on this problem the meeting will determine whether a formal or informal organization should be set up for future meetings.

Heating contractors handling burners, burner dealers, fuel oil dealers and distributors, and burner manufacturers have been invited to attend these meetings. All those who have not been in touch with their Regional Directors are invited to do so.

At this writing the Regional Directors for the Providence and Brooklyn-Queens areas have not been selected.

One regional meeting has already been held, that at Minneapolis June 19, under the direction of C. H. Chalmers. The meeting, which was well attended, discussed competitive conditions, cooperative advertising, and free service. The following resolution was unanimously adopted: "It is recommended that there shall be no free burner service or free parts beyond the regular guarantee period of one year on new installations and thereafter there shall at no time be rendered any service or installed any parts at lower than cost."

Air Conditioning Prominent at EEI Meeting

Speakers at electric utility convention discuss promotional and sales possibilities

INTEREST of electric utility companies in air conditioning was reflected at the 4th annual convention of the Edison Electric Institute at St. Louis, June 1-4. Virtually an entire session was devoted to the subject, with papers by utility men prominent in the promotion and use of air conditioning.

Three separate papers dealt with various phases of air conditioning, as follows: Home Cooling by Attic Ventilation, by W. G. Moore, Texas Power & Light Co., Dallas; Unit Air Conditioners, by R. H. Tillman, Consolidated Gas, Electric Light & Power Co., Baltimore; Review of the Utility's Position in the Air Conditioning Field, by C. E. Michel, Union Electric Light & Power Co., St. Louis.

Attic Ventilation

Mr. Moore believes that while attic ventilation should not be considered as a substitute for a complete air conditioning system, it is coming into considerable use and popularity, especially in the south, and called attention to the more than 150 installations on the system of Texas Power & Light Company. In his opinion, use of attic ventilation will become the most generally accepted method of home cooling in the South.

The popular equipment sizes use fans from 36 to 48 in. diameter, operated by ¼- to ½-hp. motors. In his estimation, maximum results are obtained when the fan has capacity enough to change the air throughout the house every minute or minute and a half. In his experience, application of attic ventilation has not yet reached the stage where it can be sold as a standard package, as each installation should still be studied carefully by a specially trained engineer, or his equivalent. Especial attention should be paid to securing adequate fan capacity, to the proper location and design of grilles and outlets, and to securing quietness in operation. Power consumption figures were given as being from 300 to 400 kw-hr. per season, corresponding roughly to an annual operating cost of $12 to $15.

Utilities in Air Conditioning

In the opinion of Mr. Michel, who has long been identified with air conditioning, there are few modern developments in the electrical field that touch the interests of the utility at as many points as does air conditioning. Mr. Michel, in reviewing the progress made in the development of air conditioning equipment, stated that in his opinion air conditioning has now emerged from the custom-built to the ready-made stage. "In the beginning it was a part of the building industry. Each job was designed for a specific purpose and the equipment for each was assembled on the ground. Then, as applications were made to comparable structures, standardization became practical and today even the large installations are made up of standard factory-built units."

Effective local assistance in the sale of air conditioning equipment depends entirely on local conditions, in Mr. Michel's view. If suitable local outlets are available for this equipment they should be cooperated with, but if they are not available then the utility should consider lending its assistance either toward establishing them or to entering into the direct sale of this equipment.

Mr. Michel also believes that "air conditioning has not reached the stage where it can be sold without referring to underlying principles. The automobile of today is sold on performance, beauty, and other attributes of that character, but in 1914 the buyer was interested in the transmission, the differential, and the internal combustion engine. So it is with air conditioning. Many prospects still desire to know why and how, and where we encounter that attitude, it must be satisfied before the sales presentation is made. On the larger installations, of course, technical knowledge is required to meet the situation. As a result, we have found that when sales ability is backed by a thorough knowledge of the mechanics of air conditioning, the best results are achieved.

"During the last six years, utilities throughout the country carried on substantial promotion activities, the results of which are being increasingly felt. Now, with business conditions improving, and with a broad public acceptance of air conditioning, we face what gives every indication of being a banner year."

Unit Air Conditioners

The purpose of Mr. Tillman's paper was to discuss the present status of unit air conditioners, their importance as both building equipment and their relationship to the future of the air conditioning industry.

He doubted if unit conditioners will radically change air conditioning from the engineering-contracting activity it is today, but believes they will have considerable effect in spreading the desire for and the use of air conditioning.

He believes that the self-contained unit should prove a stepping stone toward the complete installation, although it falls short of supplying the full year 'round need.

"Self-contained air conditioning units of sufficient capacity to care for the average small office or room in a residence, with either water-cooled or air-cooled condensers, are available today at prices ranging from approximately $400 f.o.b. factory, upward. Under favorable conditions, the cost of electric, water, and drain connections for the water-cooled condenser type would probably be within $40, and the cost of running special circuits to supply current to the air-cooled condenser type would not exceed $25. One of the most desirable features of this equipment is the fact that it is virtually 100% salvageable, so that it is readily saleable to persons occupying offices, apartments, or homes on a short-term lease basis."

The use of self-contained units, in the opinion of Mr. Tillman, presents the cheapest method of taking care of a single room, or possibly two rooms, but when more than two rooms are to be supplied economy in the installation may make desirable the use of units with an external source of refrigeration. This arrangement gives the advantage of using a single refrigeration equipment to supply cooling for the various units which may be used at different hours of the day. Especially in the case of residences it seems that such a plan would have impressive advantages.

Hours of operation and the resulting dollars in annual revenue from any kind of equipment are naturally of importance to utility companies, and Mr. Tillman pointed out that the possibilities of the unit air conditioner as a revenue producer still remain to be determined. However, based on Baltimore conditions and tests, the conditioner in an average commercial office should be expected to operate a minimum of 600 hr. per season, while similar units in residences would probably operate from 350 to 400 hr. per season. Normal commercial applications using unit type air handling equipment with external refrigeration should operate approximately 700 hr. per season.

As a result of his analysis, Mr. Tillman concluded that "the significance of the unit air conditioner lies in its promotional possibilities and the fact that it gives us a suitable medium to supply small-scale requirements. If we can make full use of it in its proper place without 'over-selling' it and without expecting it to be a panacea for all air conditioning needs, it will prove exceedingly valuable in bringing to the public mind the realization that air conditioning is available for general use now."

ASHVE and ASRE Hold Joint Session,

with corrosion, refrigeration, and building heat requirements occupying attention at busy meetings

WITH 339 registered members and guests, the semi-annual meeting of the American Society of Heating and Ventilating Engineers recalled pre-depression days. The meeting, one session of which was a joint one with the American Society of Refrigerating Engineers, was held at The Inn, Buck Hill Falls, Pa., June 22-24. The ASRE held its summer meeting at Skytop, a few miles away, the June 23 meeting of the two organizations being held at Buck Hill Falls.

Corrosion

The first paper was one on Corrosion Studies in Steam Heating Systems, by Professors R. R. Seeber and F. A. Rohrman and G. E. Smedberg, all of the Michigan College of Mining and Technology. This paper was the second of a series presenting information on an investigation being carried on as a cooperative program between Michigan College and the ASHVE. The effect of pressure upon the corrosion rate was studied and it was found that corrosion is greater at higher pressures than when a vacuum is carried in the system. The authors presented a curve showing that at 1 lb. pressure the corrosion rate was about 9.3 in. penetration per 1,000 years, while at 15 in. of vacuum the rate was only 4 in. The explanation is that at the higher pressure the gases are forced to stay in solution, and the rate of flow of condensate is greater, both conditions acting to increase the corrosion rate.

The rate of flow of condensate has an important bearing on the corrosion rate. The higher velocity tends to wash off both the protective coatings which form and also the products of corrosion which protect the metal to some extent. There is a possibility of some erosive action in cases of high velocity. Similarly, the temperature of the corroding medium is an important factor since the increased temperature drives the gases from the solution after which they are more operative as a corroding agent. However, the corrosion rate increases with an increase of temperature only up to a certain point from where it decreases rapidly with further increase of temperature.

Professor Seeber's paper excited more discussion than most, reflecting the keen interest in the subject. W. H. Driscoll, Thompson-Starrett Co., brought to the convention an exhibit of several dozen pieces of pipe and fittings from a large hotel in New York, built about five years ago, which showed the result of extreme corrosion. All of the samples were taken from the steam heating lines but, as Mr. Driscoll pointed out, the water service lines for the kitchen and plumbing were relatively unaffected.

Stokers

Two members of the staff of Carnegie Institute of Technology, Professors T. G. Estep and D. C. Saylor, reported the results of tests on an underfeed stoker burning bituminous coal. They reported that the stoker under test is satisfactory when a non-caking variety of coal is used but that caking coals would be hard to manipulate with the device they tested. They further reported that the stoker could have been improved had the fan been of proper design, and stated that the long radius bend in the coal feed passage is responsible for faulty air distribution in the fuel bed. Their final conclusions were that the best results were obtained when hand attention was given to the fuel bed.

Some criticism was made of this paper, and at least one discusser felt that any stoker which required hand attention was either not properly designed or was improperly tested, and reported that his experience with the stoker under test indicated that it was properly designed. He stressed the fact that this paper applied only to a particular stoker and that the data obtained from the test were applicable only to this stoker under the conditions of the tests. It was brought out that, in general, stokers can perform entirely satisfactorily without hand attention.

Boilers

Whether or not it is economical to add additional sections to a round boiler is frequently a question in the field when oil burners or stokers are to be installed and when the boiler is believed to be too small. A. J. Johnson and P. A. Mulcey, director and assistant director of the Anthracite Institute Laboratory, investigated this matter and reported their results in a paper entitled Relative Absorption of the Various Sections of a Round Heating Boiler. Their results indicated that on an average for several fuels the combustion chamber section accounts for 56.9% of the total heater output, the crown sheet for 17.9%, and the first intermediate section for 13.1% of the output. The decreasing value of further sections is clearly brought out by the fact that the second intermediate section acts for only 7.9% of the total output and the dome 4.2%.

According to the authors, when using stoker-fired boilers with anthracite the side walls are of minor importance as compared with the crown sheet. In view of the sootlessness of anthracite, together with the fact that it is largely a pure carbon rather than a hydrocarbon, it would seem obvious that combustion space over the fire was of minor importance as compared with radiant surfaces directly above the fire, together with well designed flue passes.

This conclusion was substantiated by tests in the Institute's laboratory, in which it was found possible to burn anthracite in an underfeed stoker set at a distance below the crown sheet just sufficient to prevent actual contact with the incandescent fuel. Outputs as high as 350,000 B.t.u. per cu. ft. of combustion space were obtained. The ideal stoker furnace, the author claimed, should have just sufficient volume to permit lighting of the fire, feeding of ashes into the ashpit, and giving access to replaceable parts.

Steam Heating

The Distribution of Steam in Heat Transfer Surface was the title of a paper by John McElgin, research engineer, John J. Nesbitt, Inc., Philadelphia, describing a means of securing a close coordination between fin and tube steam heating surface and automatic control in all stages of operation, accomplished by inserting within the usual condensing tubes additional tubes which serve the purpose of distributing steam uniformly along the length of the condensing tube.

Mr. McElgin's conclusions follow: Several of the difficulties encountered in the application of automatic temperature control to fin and tube steam heating surface are a direct result of the temperature stratification created when air is bypassed or when the steam supply is modulated.

In a system under valve control it was found that temperature stratification may be reduced by inserting steam distribution tubes within the usual condensing tubes. These tubes serve to distribute reduced volumes of steam over a maximum length of condensing tube and so effect a practically uniform discharge temperature.

This arrangement resists freezing of the condensate in the heating surface. The steam supply may be throttled within wide limits in the presence of sub-freezing air, making it possible to eliminate the positive acting preheaters usually installed to protect the controlled preheater. The conditions under which this operation is possible

are that the steam supply be continuous and that the volume be maintained above a low limit by an air stream thermostat installed in the path of the discharged air.

Any system of proportioning steam valve control as applied to fin and tube surface may be considerably enhanced by taking the proper precautions to prevent *hunting*. Aside from the type of control, the factors that determine whether or not the operation is free from this defect are: (a) thermostat differential; (b) valve size; and (c) operating steam pressures. Recognition of their influence on the control system will materially improve the final results.

Heat Pump

At the joint session of the ASRE and the ASHVE held Tuesday morning, several papers relating to air conditioning and refrigeration were presented. Perhaps the outstanding paper of the convention was that by C. W. Chamberlain, professor of physics, Michigan State College, whose paper, entitled Principles and Practice of the Heat Pump, was presented at the joint session. The greater part of Professor Chamberlain's talk was concerned with heat transfer. He told his audience of a series of experiments continued for several years and which resulted in important information concerning the thermal resistance of surface films which act as barriers to heat transfer. These films are beyond the range of the compound microscope and are studied by interferometers. These instruments have made it possible to observe and accurately measure films of thickness one and a half ten millionths of a centimeter, which is the distance over which molecules act and is called the radius of molecular attraction R.

Films one R thick cannot be reduced in thickness. They have been found to cover all surfaces and may be composed of air or any other gas, but generally consist of water derived from the atmosphere. They are always the same thickness whether composed of air, water, or oil. The pressure in these films is very high, increasing the density of the water to 1.1. These barrier films are exceedingly hard. An attempt to cut with a cold chisel and hammer the film on the surface of cast iron results in the crushing of the iron without rupturing the films covering the surface of the iron and the edge of the chisel.

When a liquid film was examined with the compound interferometer, with a resolving power 200 times greater than that of the compound microscope, it was found that when the film thickness was reduced to one ten-millionth of an inch any further attempt to thin it caused it to split in the middle. The thinnest stable liquid film is four R thick and probably consists of a liquid layer two R thick faced with two boundary layers one R thick.

Thin liquid films have been found to have a laminated structure. The thickness of these laminae is the radius of molecular attraction. Liquid films can easily be split in the middle. The pressure normal to the surface of the liquid film is very high. The surface layers, one R thick, appear to be a gradual transition from the liquid to the vapor phase, and most important of all, molecular impact with these surface layers appears to be inelastic rather than elastic.

New Heat Interchanger

Professor Chamberlain then went on to describe a new heat interchanger designed to split the surface films in the middle. Each separate globule of liquid is seized like a rock in a stone crusher, smashed into a thin sheet and passed downward with surprising velocity. The foam walls all split in the middle and the liquid contacts all of them. There is a rapid thermal interchange between the downward moving liquid and the thin foam walls and from the latter to the upward moving air. As the foam cells are small no molecule of air is far from a film wall. When thermal agitation causes an air molecule to collide with the liquid wall the impact is inelastic. If the air molecule rebounded from the transition layer only a fraction of the impacts would cause a transfer of energy from liquid to air. The impact of air molecule and film is inelastic. The air molecule enters the liquid and makes many impacts with the molecules of the film and when it finally emerges it has gained the average energy of the film molecules. Liquid molecules from the transition layer likewise enter the air space. As the air is saturated with vapor the number of molecules entering and leaving either medium remains constant. The rate of transfer of heat units is very high.

Air Conditioning Economics

Application Factors Which Govern the Selection of Refrigerating Equipment for Air Conditioning Service were discussed by J. R. Hertzler, manager, air conditioning division, York Ice Machinery Corp. Mr. Hertzler's paper related to compression type refrigeration equipment using dichlorodifluoromethane as the refrigerant. According to the author, the load factor and the actual loads at which the equipment will be required to operate determine the number of compressor units or the capacity regulating devices of the individual compressor units required. Fixed charges on a particular refrigeration equipment should be calculated at 15% of the initial cost per annum.

The cost of the driving energy and the first cost of the prime mover of the compressor generally determines the type of drive selected, while the amount of condensing surface justifiable is variable and dependent upon operating costs or the balance of first and operating cost which results in the lowest annual expense to the owner.

Use of combined cooling tower condensers may be justified on the basis of reduced annual fixed and operating charges or by other causes such as inadequate or improper condensing water supply or limited sewer capacity.

A brief paper by D. C. Morrow on Water Supply as Affected by the Demand for Summer Air Conditioning, was presented by title.

Progress in Air Conditioning

W. H. Carrier presented an extended paper entitled Progress in Air Conditioning in the Last Quarter Century, in which he reviewed briefly the development of the art prior to 1911, the year in which he presented his psychrometric formulas before the ASME. He then listed eight improvements in the art since 1911, as follows:

Scientific measurement of human comfort.

Improved heat transmission surface for heating and cooling.

Improved methods of heat removal (refrigeration), including new and improved types of refrigerating machines and new refrigerants.

Improvements in the methods and apparatus for air distribution and humidity control.

Improvements and simplification in the method of dust removal.

Adequate lowering of objectionable sound level of ventilation and air conditioning systems (sound absorbers).

Development of reliable low cost unitary cooling and air conditioning equipment.

This paper concluded with a summary of the extension of air conditioning to new fields.

Thermostats

At the opening of the Wednesday morning session, D. D. Wile described the Development of Testing Apparatus for Thermostats as carried out at the Detroit Lubricator Company's laboratories where the author is chief engineer of refrigeration and air conditioning. He described a novel testing method used to determine the accuracy of thermostats in the control of air temperatures, and to assist in recent developments of new instruments.

L. A. Harding, past president of the society and president of the L. A. Harding Construction Corp., presented a paper on Pyrheliometers and the Measurement of Total Solar Radiation. Mr. Harding reviewed the de-

(Concluded on page 68)

Automatic Controls for Residence Installations with Central Fans

CENTRAL fans used in residences in connection with heating or cooling are no different essentially from fans used in those systems described in previous articles in this series. In so far as residence fans are operated continuously the control problems in residences are the same as those already discussed and the control methods and arrangements already shown can be used in residential installations.

However, residence installations differ from those made in other buildings in that the fan control often has to be more closely coordinated with the combustion control and in that the control on these installations must often be less extensive and complicated than is justifiable on commercial jobs.

Automatic control of residence systems is both important and necessary if the maximum of performance is to be secured. The fact that this control must be both reliable and simple makes it essential that the problem be given close study in order to insure suitable selection of equipment and correct functioning of the whole installation.

It is not intended in the present article to attempt to cover the whole subject, for it is too broad. The idea is to show how automatic controls may be applied to residence installations in certain typical cases and to select those cases and methods in such a way as to secure reasonably good variety. As in previous articles in this series the procedure is from the simple toward the complex.

It is not even proposed to cover all methods of heating and cooling residences but to include only those where there is a central fan. There are countless cases where no such fans are used and these cases are omitted here, not because they are not important, but because the equipment and methods used in securing automatic control in such instances are matters of long standing knowledge. Neither is the case of the attic central fan used for summer cooling included, for while plants for winter use only and for use the year 'round are shown, the intent is not to include central fan plants intended for summer use only. While zoning of automatic controls to secure operating flexibility is common practice it is not discussed here because of lack of space.

Control of combustion is usually an essential part of automatic control in residences but it too is a matter of such common knowledge that it has seemed desirable to exclude it from detailed discussion here. So also does the type of fuel burned greatly affect control methods but fuel selection is so much a subject by itself that attention is diverted from it here as much as possible. A timing program may also be used in connection with virtually any method of automatic control in a residence and experience shows that such program equipment is often well worth its cost, but again this phase of automatic control is excluded because of space limitation.

Methods of Heating and Cooling

Heating and cooling of residences where there is a central fan can be accomplished in a great variety of ways and all of these ways are in use to great or small degree. As a result there is no clear cut classification of methods. One classification, and one which is useful in many ways, is to classify on the basis of the furnace or boiler used in winter. Another method makes use of the distinction of whether there are direct radiators or not. A third classifies on the basis of the number of functions of air conditioning which a given plant produces. In the absence of any uniformity in practice we have adopted the kind of boiler or furnace used in winter. On this basis the following types of plants can be identified:

1. **Forced warm air furnace plants**
2. **Boiler plants**
   - **(a) steam or vapor**
   - **(b) hot water**

Plants of Class 1 always transfer heat to the air in winter by passing the air directly over a surface on the other side of which there is a fire or hot combustion gases. Plants of Class 2 heat the air by passing it over surfaces kept hot by steam or hot water. Either class of plant may or may not be used with direct gravity radiators in the heated room although only plants of Class 2 are commonly so used. This fact does not seem to be always fully understood.

Another point should also be noted. In rooms where there are direct heating or cooling surfaces, heating or cooling can be kept entirely independent of the fan operation if desired, while in rooms not so equipped there is no means of heating or cooling at times when the central fan is not operating.

Methods of Securing Control

There are two general methods of securing control of the system where a central fan is used in residences. One is to start and stop the fan at intervals; the other is to let the fan run continuously.

When the fan starts and stops it must do so in coordination with the combustion and cooling devices so that air at the proper temperature will be delivered. The amount of heating or cooling done varies with the time the fan is operating and starting and stopping thus serves as a means of varying the fan's delivery to meet changes in demand. When the fan operates continuously and thus delivers a steady volume of air, control is achieved by varying the temperature of the air delivered, to meet changes in demand. Both these methods of securing control are illustrated in the accompanying diagrams.

Switching-Over

Where residence fan plants are for use in both summer and winter the same problem of taking the one

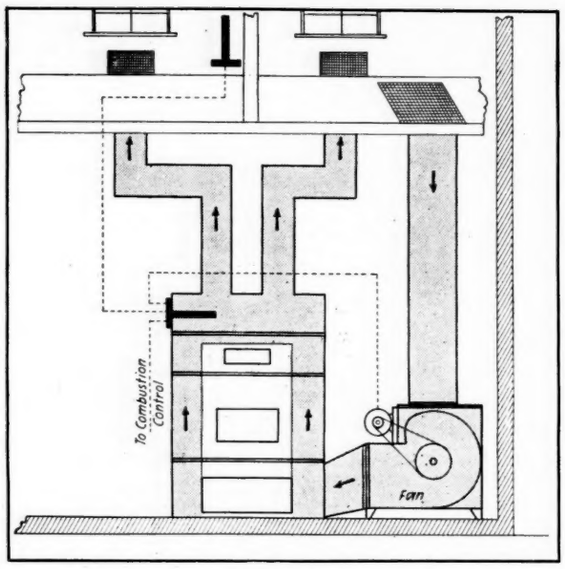


Fig. 1

plant out of service and putting the other one in is encountered as has been explained in previous articles in this series. Methods of accomplishing this switch-over are essentially the same as those described in connection with central fan plants in general. While only manual methods of switching are illustrated in the accompanying diagrams, fully automatic methods are available and used where desired.

Form of the Diagrams

The accompanying eight diagrams show in principle various methods of accomplishing automatic control of residence fan installations. The diagrams are not to scale in any direction nor do they show actual equipment. They do show relative positions of the control devices and aim to make the functioning of the separate controls understandable.

While the form of these diagrams has had to be changed somewhat from that used in previous articles of this series, still all eight of these diagrams are uniform in general outline. The symbols used for representing the control devices are the same as those used in diagrams in earlier articles both for uniformity and to help make clear the fact that the same valves, motors, and controllers which are used on central fan systems generally are also used in residential fan installations.

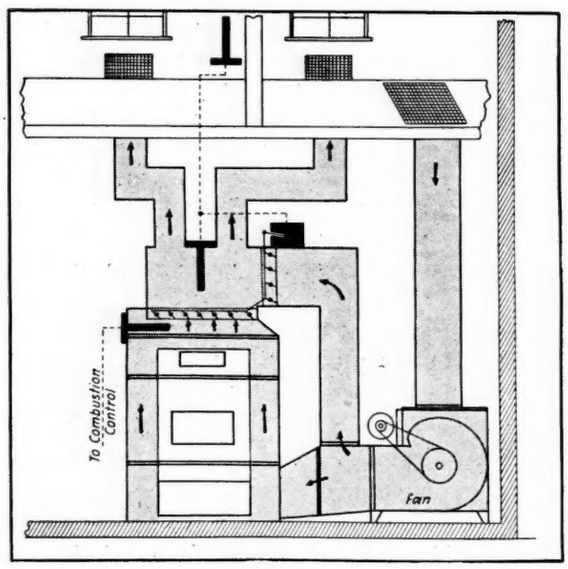


Fig. 2

It will be noted that the first four diagrams show various cases where a warm air furnace plant is used and thus illustrate Class 1 plants, while the last four represent boiler plants and are thus what we have classed as Class 2 plants.

In all the plants shown in the diagrams there are many variations possible both in the control arrangements, functions, and in the location and design of the detailed parts of the system. In interpreting the diagrams keep carefully in mind that they are meant to be diagrammatic only and that when details approaching construction details are shown they are merely for the purpose of lending a certain amount of realism to the diagram outlines.

Fig. 1 shows an arrangement in common use for winter heating purposes where a warm air furnace and an electrically driven blower serve to heat and circulate the air. There is no connection to outside air and the plant is thus a heating plant only, and no provision is made for handling ventilation air.

The control arrangement shown provides for combustion control and intermittent operation of the blower, both subject to the direction of a thermostat located in one of the rooms.

A fall in room temperature affects the room thermostat and causes the combustion device to act to increase the heat supplied to the air in the furnace jacket, thus raising the temperature of the air surrounding the temperature controllers located in the top of the furnace jacket. When this air temperature reaches the set point of this controller the blower begins to operate and heated air is sent through the ducts to the rooms, causing the room air temperature to rise. This rise in room air temperature affects the room thermostat which then causes the combustion device to either stop or else to produce heat more slowly, and stop the operation of the blower as well.

The arrangement shown is typical and equipment can be so selected that this method can be adapted to any fuel and to any method of firing. Safety controls are provided as a part of the device to take care of the contingencies introduced by the particular fuel and firing method being used.

It will be noted that Fig. 2 is similar to Fig. 1 in that it shows a warm air furnace and an electrically driven blower for heating and circulating the air; and that there is no connection to outside air.

The method of control and the arrangement of the control device is distinctly different from that shown in Fig. 1, however. In the first place the blower operates steadily instead of intermittently as in Fig. 1. In this respect this arrangement is similar to those shown in previous articles in this series in which the central fan operates steadily.

Steady operation of the blower means that a substantially constant volume of air is being passed through the duct system. Variation in the amount of heat which this volume of air carries with it is secured

by varying the temperature at which the air is discharged into the room. This variation is obtained by a bypass duct around the furnace and a compound damper which is positioned by the room thermostat.

To function properly this method of control needs a supply of air at the top of the furnace at a temperature always higher than that in the bypass duct. This is secured by causing the combustion device to operate under the command of a controller placed in the top of the furnace jacket. This operates to maintain a steady temperature of air in the furnace bonnet just below the damper.

With a steady air temperature at this point, a fall in room temperature causes the room thermostat to position the compound damper to close the bypass and open the damper above the furnace passages. A rise in room temperature reverses this action. The controller shown in the duct acts as a low limit and prevents too cool air from being discharged from the grilles.

As in Fig. 1 this arrangement is typical and can be modified in detail to meet the requirements of fuels and firing methods and any necessary safety controls can be added at will.

In Fig. 3 the typical arrangement of Fig. 2 is modified by the addition of an outside air connection and a humidifying device. It thus becomes a heating and a ventilating plant with means of automatically controlling the humidity in winter. The particular arrangement of controls shown uses outside air to reduce the heating loads when conditions permit doing so.

The room thermostat, the controller in the duct, the controller in the furnace bonnet and the necessary safety controls all operate as just explained in Fig. 2.

A temperature sensitive controller in the outside air acts in conjunction with the humidistat in the room to secure control of the humidity. They are so arranged that as the outside temperature falls the relative humidity maintained inside also is reduced in the degree necessary to prevent condensation forming on the windows. These controllers actuate the valve in the water line leading to the water sprays and cause the sprays to add moisture to the air on a fall in the room humidity but this valve is prevented from opening if the blower is not running for any reason.

An outside temperature controller also controls the position of the compound damper located in the return duct from the room and in the outside air duct. The amount of outside air admitted thus increases as the amount of return air decreases. The amount of outside air, however, will be reduced if outside humidities are excessive.

Fig. 4 shows Fig. 3 modified to include summer cooling using a cooling coil located in the bypass air duct around the furnace. This arrangement is thus one suitable for a year 'round plant employing cooling from any source in the summer. A manual switch-over between summer operation and winter operation is shown although automatic means can be employed.

In winter operation the controls function essentially as explained in Fig. 3, except that the valve on the cooling coil must be held shut. The controller on the furnace bonnet governs the operation of the combustion

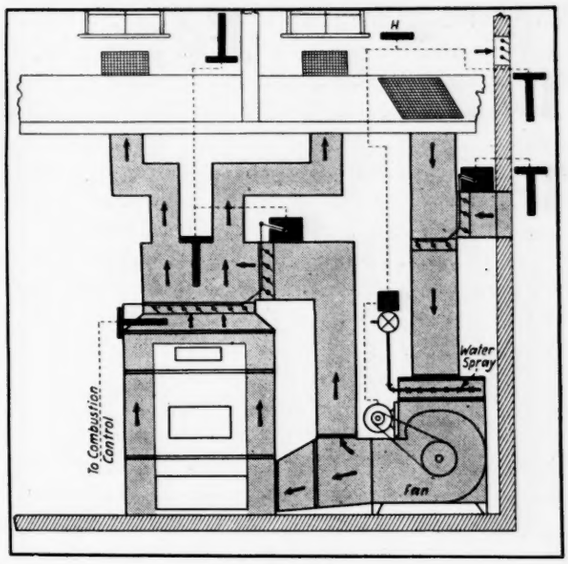


Fig. 3

device, and a low limit control in the duct prevents the delivery of too cold air from the grilles.

In summer operation the bonnet controller goes out of operation completely so that the combustion device is inoperative. Also the valve leading to the water sprays is held shut so that the sprays cannot operate.

The room thermostat functions exactly as in winter operation and positions the damper at the top of the furnace to keep a definite room temperature. The damper motor is also under the direction of the duct controller which acts as a low limit to position the dampers when necessary. This damper motor also actuates the valve in the line leading to the cooling coil to open this valve when the mixing damper in the furnace bypass duct starts to open from a fully closed position. The summer room humidistat also acts on this damper motor whenever the relative humidity in the room rises above its set point.

The outside temperature controller which actuates the compound damper in the outside air and return air ducts positions these dampers to admit outside air

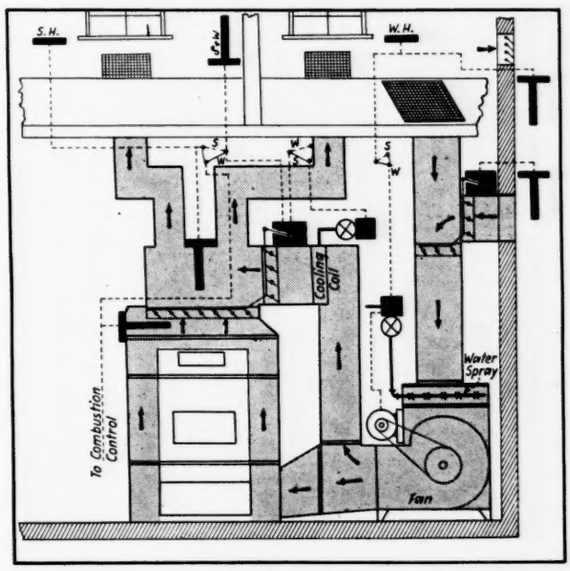


Fig. 4

whenever the outside temperature is low enough to reduce the loads on the cooling coil. A humidity controller may also be used as a limit control to close the outside air damper if the outside humidity becomes excessive.

In Fig. 5 is represented an intermittently operated central fan used in conjunction with a direct radiator winter plant. There are radiators in all the rooms and the central fan circulates air for humidification only. The heating coil shown in the duct may or may not be used. If the grilles for air discharge into the room are located under or behind radiators the air is warmed by the radiators and no coil in the ducts is necessary. This method is readily applied to existing buildings and is in wide use. Summer cooling may be obtained by installing a cooling coil in the duct. While Fig. 5 shows a hot water plant, the same arrangement can be used with steam or vapor with only minor changes.

The controller in the hot water boiler keeps the water at a constant temperature by means of the combustion controls. Hot water does not leave the heater and circulate, however, except when the circulatory pump is operating. This circulator is under the control of the room thermostat. On a fall in room temperature the circulator starts, and forces open the special valve at the top of the heater. Hot water then flows to the direct radiators and to the heating coil in the duct. As soon as the hot water reaches the temperature sensitive controller located in the return line from the duct heating coil, the blower starts. This method of control prevents the blower from operating unless the heating coil is hot, thus preventing cold air being delivered to the grilles in winter. The room humidistat opens the valve leading to the water sprays on a fall in room relative humidity and closes it on a rise beyond its set point. Arrangements may be made whereby the valve in the water line will not open unless the blower is running. While automatic controls on the direct radiators are also in common use they are not shown in the diagram because we are here concerned primarily only with the control of fan operation.

Fig. 6 shows a case of intermittent central fan operation in a winter plant but in this case it will be noted that only certain rooms in the building contain direct radiators and that air is not supplied to them by the fan. In the rooms not containing direct radiators the air passing the central fan carries the whole supply of heat. This is a case of a building using both a direct radiator plant and a warm air plant for winter purposes. It is sometimes called a "combination" plant for this reason. While it is shown using steam or vapor, hot water can be used with only minor changes in the control arrangements.

A constant steam pressure is maintained in the boiler by the combustion control. The room thermostat positions the valve in the steam line leading to the duct coil and admits steam to it as the room temperature drops. The controller in the duct leading to the rooms acts as a low limit control and takes command of the steam valve away from the room thermostat if the duct temperature becomes too low. The controller in the return line from the duct coil is affected by the rise in temperature in the return line as steam is admitted to the coil, and starts the blower. Thus the blower cannot operate unless the heating coil is hot and cold air cannot be discharged into the rooms. The room humidistat subject to the action of the controller in the outside air, opens the valve leading to the water sprays on a fall in the relative humidity in the room and closes the valve when the relative humidity rises above the set point. The outside controller prevents a relative humidity being maintained inside at so high a value as to result in frosting of the windows. The control of the water spray valve is so arranged that the valve cannot open unless the blower is operating.

Fig. 7 illustrates a control arrangement when the plant of Fig. 6 includes provision for summer cooling with a surface coil and is thus converted into an all-year plant. A manual switch for changing from summer to winter operation is shown although automatic means may be used if desired.

When the change-over switch is in its winter position the plant operates as just explained under Fig. 6 and the valve leading to the cooling coil is held shut. Throw-

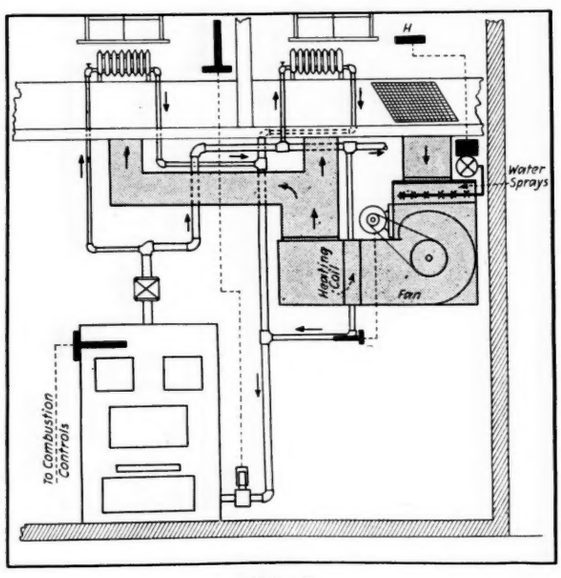


Fig. 5

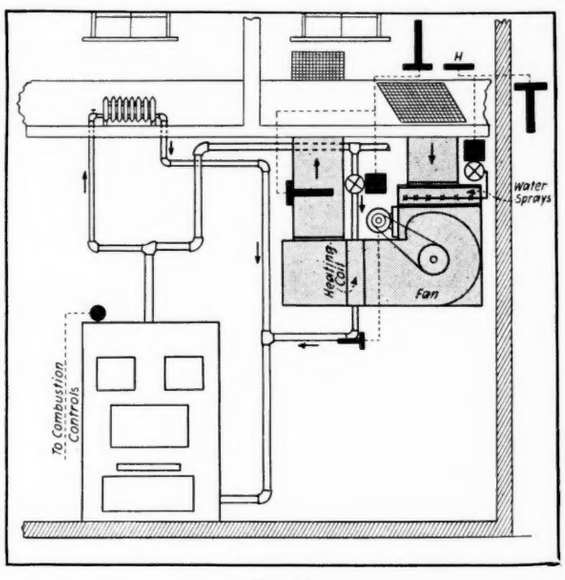


Fig. 6

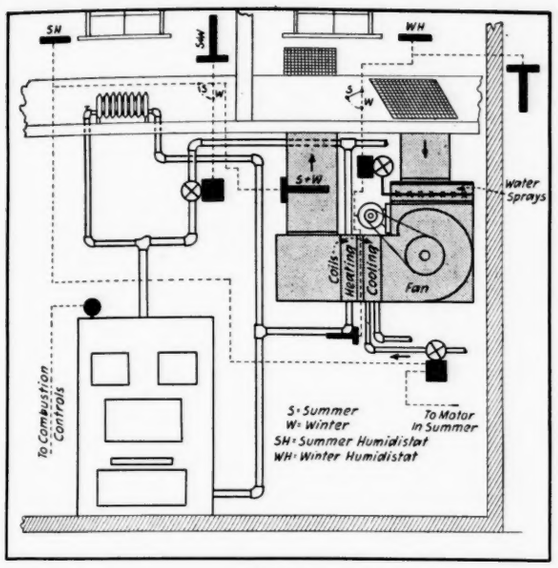


Fig. 7

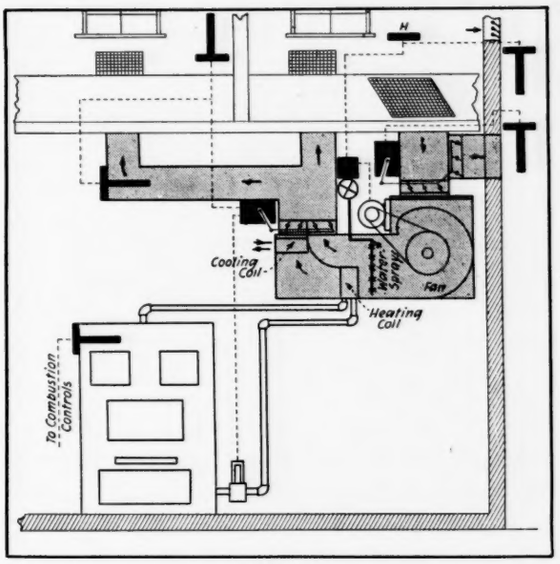


Fig. 8

ing the change-over switch to its summer position results in the winter humidistat and its outside controller being taken out of operation entirely with this action holding the valve leading to the water sprays tightly shut. The plant then operates under the command of the year 'round room thermostat which acts on the valve leading to the cooling coil instead of the one leading to the heating coil.

On a rise in room temperature the room thermostat opens the valve leading to the cooling coil, the blower starts, and delivers cooled air to the rooms. The duct controller takes command away from the room thermostat if the air temperature falls too low. The room humidistat also acts as a limit control and takes command of the valve if the relative humidity becomes excessive.

In Fig. 8 is illustrated a plant which, while using a hot water boiler to generate the winter heat, does not use radiators. All the heat is carried to the room by warm air passing through the central fan. It will be noted that this arrangement of controls is identical with that of Fig. 3. The control acts exactly as described under Fig. 3. A cooling coil is shown in the diagram but without the summer controls being connected. Addition of summer controls would cause operation essentially similar to that described in Fig. 4.

Anthracite Gains

THE production of Pennsylvania anthracite for domestic uses increased 19.8% in 1934 as compared with 1933. The total tonnage of domestic size of hard coal produced in 1934 was 33,269,928. During the same year there were produced 7,785,412 tons of buckwheat No. 1. Byproduct coke sold for domestic use shows a decline from 10,215,360 tons in 1933 to 10,174,114 tons in 1934.

These data are contained in the recently published booklet entitled "Coal, a Statistical Appendix to the Mineral Year Book—1935." It is published by the Bureau of Mines and is obtainable from the government printing office.

Unfortunately, from the standpoint of marketers there have never been definite figures available as to the utilization of soft coal for the heating of buildings. As the publication points out, bituminous coal used for domestic use is estimated to be somewhere between 66 million and 77 million tons per year. This leaves, however, a wide range of error in any estimates involving the exact distribution of fuel for building heating. Use of range oil and other light fuel oils has increased sharply the last few years, the former from less than 7 million barrels in 1932 to nearly 16 million barrels in 1934.

TOTAL SUPPLIES OF FUELS COMMONLY USED FOR DOMESTIC PURPOSES IN THE UNITED STATES 1924 AND 1931-34

[Wherever available the figures represent the quantity actually consumed for domestic heating or for heating offices, apartments, hotels, schools, hospitals, etc. Where such figures are not available, but where the fuel is known to be used chiefly for domestic purposes, the total production (or imports) is shown to indicate the trend of growth]

	1924	1931	1932	1933	1934
Solid fuels (net tons)					
Pennsylvania anthracite production:					
Shipments of domestic sizes	56, 576, 296	35, 437, 946	29, 096, 962	27, 755, 333	33, 269, 928
Shipments of Buckwheat No. 1 [1]	9, 510, 508	7, 956, 978	6, 735, 313	6, 628, 785	7, 785, 412
Shipments of smaller steam sizes	11, 160, 695	9, 240, 931	8, 029, 388	8, 954, 321	9, 700, 962
Local sales	3, 043, 939	2, 901, 117	2, 810, 387	3, 249, 552	3, 285, 936
Total commercial production	80, 291, 438	55, 536, 972	46, 672, 000	46, 584, 961	54, 042, 238
Anthracite exported	4, 017, 785	1, 778, 308	1, 303, 358	1, 034, 562	1, 297, 610
Anthracite imported, chiefly from United Kingdom and U. S. S. R. (Russia)	117, 951	637, 951	607, 097	456, 252	478, 118
Fuel briquets produced	580 470	698, 316	478, 604	530, 430	704, 858
Fuel briquets imported	38	60, 950	80, 288	42, 395	
Byproduct coke sold for domestic use	2, 812, 771	8, 376, 652	9, 422, 343	10, 215, 360	10, 174, 114
Beehive coke sold for domestic use	139, 886	113, 665	207, 857	276, 677	346, 131
Coke imported	82, 833	103, 563	117, 275	160, 573	160, 934
Gas-house coke sold	[3] 1, 400, 000	[3] [4] 813, 400	[3] [4] 656, 000	[3] 498, 000	[3] 513, 200
Petroleum coke produced	761, 100	2, 032, 000	1, 789, 000	[4] 1, 580, 000	1, 300, 000
Anthracite and semianthracite produced outside of Pennsylvania	704, 513	507, 140	454, 028	350, 068	380, 055
Bituminous coal for domestic use	(5)	(5)	(5)	(5)	(5)
Oil (barrels of 42 gallons)					
Domestic heating oils:					
Range oil [6]	(7)	4, 549, 000	6, 841, 000	[4] 10, 269, 000	15, 756, 000
Other light fuel oils [8]	5, 021, 000	24, 848, 000	44, 264, 000	50, 140, 000	60, 822, 000
Commercial heating oils [9]	(7)	15, 731, 000			
Liquefied petroleum gases, domestic	(7)	364, 200	386, 800	395, 900	421, 000
Gas (million cubic feet)					
Natural gas consumed for domestic use [9]	285, 152	330, 897	385, 887	368, 774	379, 497
Manufactured gas sold for domestic and house-heating purposes	(7)	275, 318	[3] 246, 970	[3] 226, 557	[3] 233, 800

[1] A considerable part of the Buckwheat No. 1 is used for domestic purposes.
[2] Partly estimated.
[3] Based on figures from Census of Manufactures.
[4] Revised.
[5] Between 56,000,000 and 77,000,000 tons a year.
[6] Oil used for heating houses, hot-water heating, and cooking.
[7] Data not available.
[8] Includes furnace oil.
[9] Used for heating offices, hotels, apartments, schools, hospitals, and buildings other than houses.

—Table from "Coal, 1934"

WHAT READERS SAY • • •

Hot Water

... Regarding domestic hot water heating, we feel that on the smaller tanks (up to 60 gal.) it is not necessary or even desirable to place them horizontally. Will you please let us know what is the best practice in respect to this? And if possible, why it is not necessary to do this in the smaller sizes?

Long Island City, N. Y. C. W. S.

It seems to be generally conceded through the trade that when a tank is less than 20 in. in diameter it should be placed vertically. A good many of the domestic tanks, of course, have diameters smaller than 20 in., and should therefore be set vertically. The reason for this is that the general idea is not to heat the entire tankful of water, but to provide conditions inside the tank so that a layer of very hot water will float on top of a layer of cold water. Unless this is done what results is a tankful of rather lukewarm water. In order to do this it is necessary that the circulation in the hot water and the corresponding feeding in of cold water may take place under conditions which will not disturb the two strata of water in the tank. If a small diameter tank is set horizontally the consensus of opinion seems to be that it is not possible to get an arrangement which will let the hot water collect on top of the cold water, still have enough capacity in the tank, and not cause the two layers of water to start mixing together.

●

Boiler Cross-Section

My attention was attracted to an article in the April, 1936 issue entitled "How to Make Surveys for Stoker Installations," by Noel Cunningham.... How do you ascertain the cross-section of the cast iron sectional boiler? Is it what we generally recognize as the grate area? I have endeavored to solve your meaning and have not satisfied myself that I understand your explanation.

Manheim, Pa. C. B. W.

In this article by square foot of horizontal cross-section the author referred to the measurement at the firedoor and not at the grate. The author's reason for this is that some boilers are larger in area at the firedoor than at the grate level and since the use of underfeed stokers eliminates the use of grates, he feels that this is a better position at which to measure the area.

●

Design Temperatures

I am endeavoring to obtain the outside design temperatures used throughout the heating industry for as many cities in the United States as possible.

Pittsburgh, Pa. G. L. B.

Material on outside design temperatures is contained in HEATING & VENTILATING'S Reference Data Sheet Nos. 57-58. You will note that this sheet includes design temperatures for both summer and winter conditions. It includes the principal cities fairly well scattered over the country, and these temperatures for nearby cities are usually taken as being the same as those for the cities listed in the table.

The sources of the information are readers of HEATING & VENTILATING who, in answer to a questionnaire from us, indicated the temperatures which they used in the field and which they have found to give them good working results. This sheet also gives the lowest recorded temperatures as reported by the Weather Bureau. In case you do not want to take the experience figures as given by our readers you can take the lowest recorded temperature and set up a rule of your own; there is no general practice in this point. The nearest approach to the general rule is that in sizing winter plants the outside design temperature is often taken arbitrarily as being 15F higher than the lowest recorded temperature.

●

Diesels for Heating, (1) . . .

I have just read the article entitled "A Diesel Engine for Heating?" in the April, 1936 issue of HEATING & VENTILATING. For the last three or four years I have been working on this same subject and have had a plant operating in my home now for about two years. From the very inception of our heating unit we decided that a diesel engine was not suitable for our use, due to the fact that at anything but full load much free air is passed through the engine and then through the heat exchanger which, of course, is not desirable. Furthermore, the efficiency from an oil burning standpoint of the diesel engine shows high efficiency only at from about three-quarters to full load and the curve peaks sharply off at anything below three-quarters load. Because of this fact we started out by using the Hesselman engine built by the Waukesha Motor Company, which is a fuel injection engine of comparatively low compression and depends upon spark plug ignition. This engine readily burns No. 2 and No. 3 furnace oil. The chief objection to the engine is the cost, which is high because of the cost of the fuel oil pump and the necessity of a very efficient magneto.....

The engine we now use has much higher temperature exhaust gas than any diesel engine which again increases our overall efficiency in heat (B.t.u.'s) from the oil given off to the house as great at 92%.

He-Li-Po, Inc., Greenwich, Conn. OGDEN MINTON, President.

●

and (2)

I have just read with a great deal of interest your article entitled "A Diesel Engine for Heating." We have been heating a home in this manner for the past two years, the first year with a Waukesha fuel oil engine and this past year with a 15-kw. generator set hooked up to a Ford engine and have adapted to this a stratifying device in which we have been burning fuel oil.

I notice that you speak of installation cost. By using this Ford engine which can be purchased very cheaply, it gives you a setup which runs much lower than the figures given in your article.

We also have developed and have in operation a generator set in an air conditioning job using ductwork, supplying heat as shown in the blueprint enclosed.

Greenwich, Conn. J. R. J.

Largest Air Conditioned Hotel Has Six Zone System

By JOHN R. HERTZLER†

One hundred years ago this spring, in the famous Battle of the Alamo, 185 Texans died in defending the garrison at San Antonio against 3,000 Mexicans. Centennials are under way or planned for in many Texas cities this year commemorating this and other stirring events in Texas during 1836, and the attention of the nation is focused upon the Lone Star state. In progressive San Antonio, the third largest city in the state, is located the newly modernized St. Anthony — the world's largest completely air conditioned hotel, here described.

TAKING a significant step in air conditioning for the hotel business, the St. Anthony Hotel of San Antonio, Texas, last year had a large central type air conditioning system installed for its lobby, dining rooms, offices, shops and all of its 450 guest rooms, making it the largest completely air conditioned hotel in the world.

Like any radically new development or extra public service that breaks sharply with established practice, the complete air conditioning of hotels has been slow in general acceptance, but this year hotel owners are giving serious consideration not only to the obvious benefits of human comfort, but also to the proposition that investment in a properly designed air conditioning system will pay for itself in increased business just as it does for restaurants, stores, and theaters.

While hotel owners have air conditioned their dining rooms, coffee shops, and public spaces, year 'round air conditioning for all guest rooms, with heating and humidity control in the winter, cooling, washing, and dehumidifying in summer, and an ample supply of ventilation air, has been adopted by only a few smaller hotels.

The owner of the St. Anthony Hotel is Ralph W. Morrison, a leading industrialist of the southwest who until recently was a member of the Federal Reserve Board. In embarking on an extensive modernization program for the hotel, Mr. Morrison decided to make air conditioning the outstanding feature of the new St. Anthony.

The hotel has been thoroughly remodelled and modernized. Two buildings have been joined together to form one, two additional floors have been added to the west wing, and the exterior of the whole building remodelled with an architectural treatment employing stucco. New high speed elevators have been installed, and the main floor considerably altered to secure a better arrangement of the lobby.

The demand for rooms since air conditioning was provided, frequently with a waiting list, testifies to

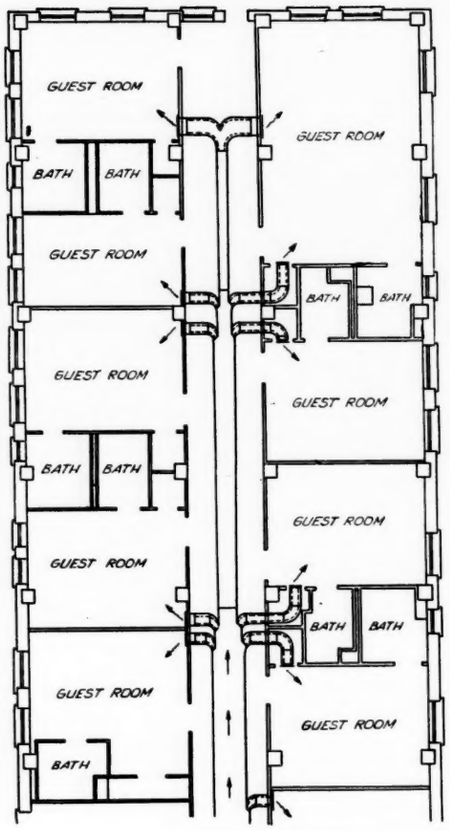
†Manager, Air Conditioning Division, York Ice Machinery Corporation.

the wisdom of this decision.

The air conditioning system, which was installed by the Houston branch of the writer's company, furnishes a total of 140,000 c.f.m. of conditioned air for the hotel's entire net occupied space of 1,250,000 cu. ft.

The air is washed, cooled, dehumidified, and circulated in summer to a temperature of 80 F with a relative humidity of 50%. The same system of ducts which supplies the air in summer is utilized for winter operation also. The old radiators have been abandoned.

During both summer and winter 30,000 c.f.m. of outdoor air will be introduced. This is drawn in through ducts from patios located well away from the dusty air of the street. Windows will be kept closed at all times. Upon telephoned request to the engineer, the window locks will be opened, but in this event the engineer will turn off the air conditioning for that room. Also, for guests who have a prejudice against air conditioning, the system is inoperative for a portion of one floor which has screened and openable windows.

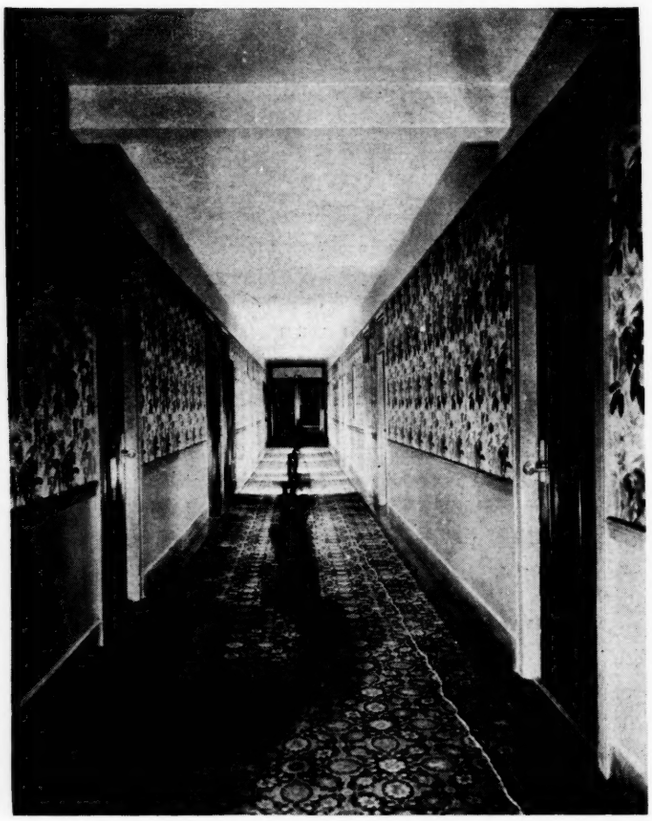


Floor plan of a typical wing of the St. Anthony Hotel, showing how conditioned air is distributed to each room through ducts in the corridor.

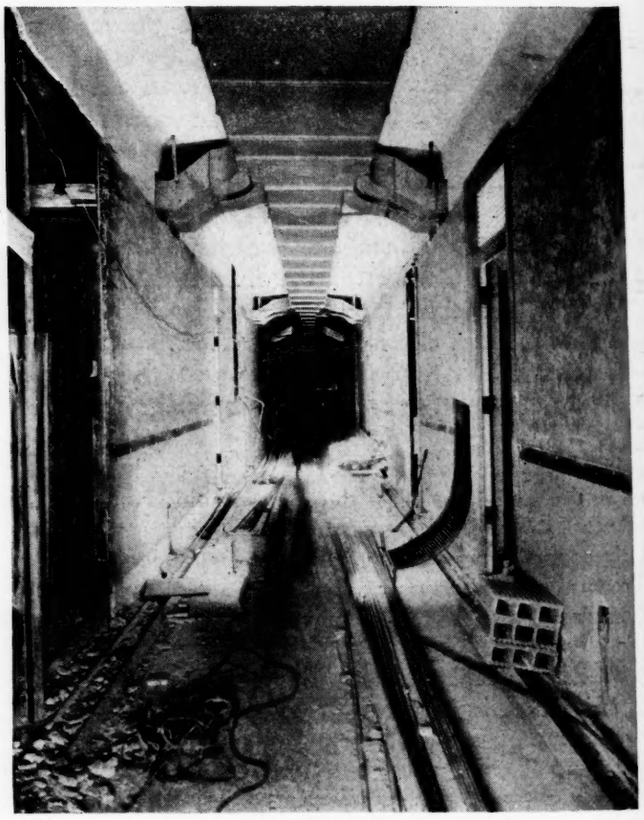
Each guest room is provided with a small hand control knob which regulates a damper on the air supply to that room, so that each guest can adjust the air conditions in his room to suit his individual taste.

The system is what is known as the central type, with all refrigerating and air conditioning equipment installed at one point, in this case the basement, with conditioned air supplied to all parts of the building by means of ducts. In the St. Anthony installation, even the fans and blowers for forcing the air throughout the building were placed in this basement space, which is an advantage in keeping noise and vibration away from the inhabited portions of the hotel.

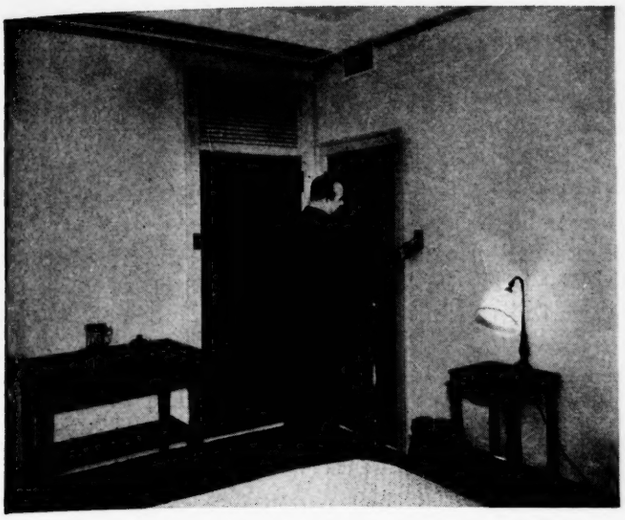
The building is divided into six zones, each zone being conditioned by one air washer. The zone system was adopted in order to handle spaces with similar load characteristics with the same air washer, and to avoid intermingling of air between various departments of the hotel.



1—*Typical corridor before air conditioning was installed in the St. Anthony Hotel.*



2—*Modernizing begun. Air supply ducts erected overhead; return air grilles replace transoms.*



Guests in the hotel can regulate the conditioned air to suit their own taste.

The air conditioned coffee shop of the St. Anthony Hotel.

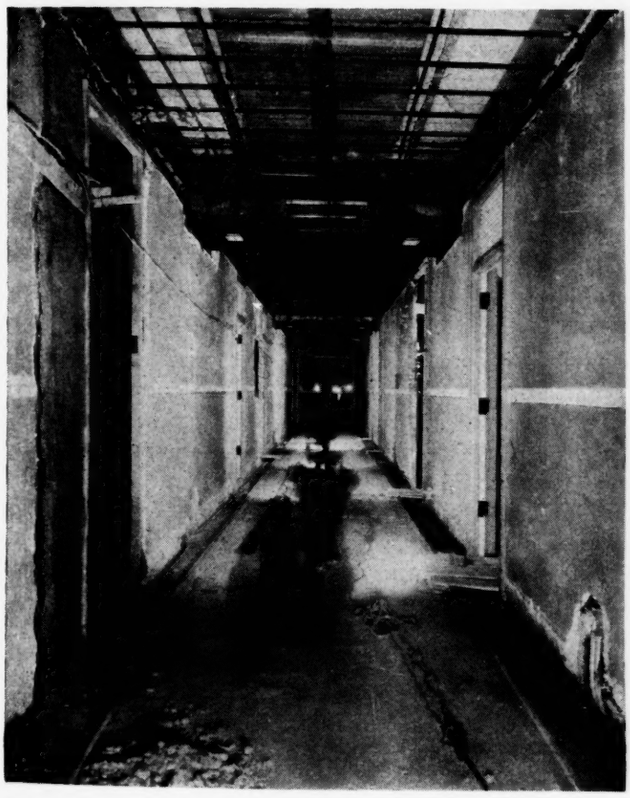
Thus, there is an air washer for (1) guest rooms in the east side of the building, (2) guest rooms in the west side, (3) coffee shop, dining room, sun room, (4) ballroom and tapestry room, (5) lobby, offices, Rotary Club room, and (6) the barber shop and beauty parlor.

During the morning hours when the heat effect of the sun will be greatest on the east side of the building, the rooms on the east side will be supplied with more cooling than those on the west side, and later in the day when the hot afternoon sun beats down on the west side, the air washer for that portion of the building will be called upon for more cooling. In winter, the heating effect of the sun is again taken into account automatically by this zoning system of air conditioning.

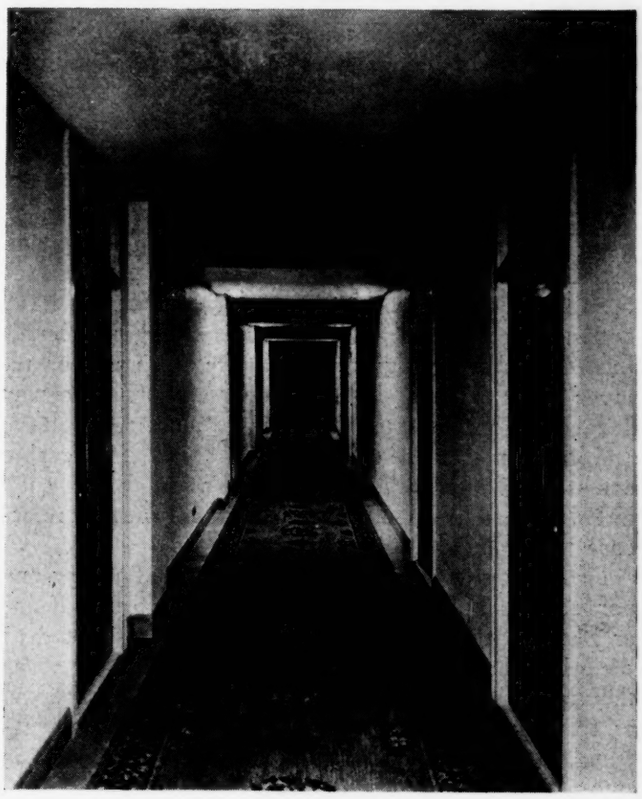
The refrigerating equipment which cools water for the air washers consists of two 12½ x 10 in. compressors, one 14 x 10 in. compressor, two large water cooling tanks, and two shell and tube condensers. Combined capacity of this equipment is 350 tons of refrigeration.

The two identical compressors are driven by 125 hp. 300 r.p.m. synchronous motors, while the 14 x 10 in. machine is driven by a 150 hp. 300 r.p.m. synchronous motor. Power is supplied to the motors at 2,300 volts.

Each compressor has a partial bypass control so that



3—*Modernizing proceeds. Steel lath in place overhead for false ceiling.*



4—*Completed corridor with walls painted and woodwork refinished.*

it can be operated economically at reduced loads. This is a highly desirable feature for operation when full cooling capacity of the system is not necessary.

Air drawn through the air washers is carried by ducts up to the spaces conditioned. The problem of finding a place to install ducts in an existing building is sometimes a serious one, but in the case of the St. Anthony this was conveniently solved by appropriating two elevator shafts which were abandoned in the course of modernizing the building.

At each floor branch ducts conduct air to each of the guest rooms. These were placed in a false ceiling of the corridors, and furred in, so that it is impossible to tell that air ducts are concealed in the ceilings.

Return air from each room leaves through soundproof louver type grilles, specially treated to reduce transmission of any noises, which were installed over the doors where the transom was formerly located. The return air is drawn to the main return grilles in the halls, and carried back to the air washer for reconditioning. All ducts are lined with acoustical felt to eliminate transmission of sounds.

Suggestions for Fireproofing Air Conditioning Installations

AS YOU know, efforts are constantly going on to make building codes better and to see that they keep up with the times and do not merely represent hysterical attempts to react to some appalling catastrophe. There is no doubt but that the requirements of today represent a more intelligent grasp of the problem than did those of fifteen or twenty years ago. The fundamental reasons for building laws are: safety from faulty construction; safety from fire, and safety from unsanitary conditions. Speaking of these three things in reverse order named: Air conditioning will to some extent eliminate the unsanitary conditions in a building by the removal of dust and odors and bringing fresh tempered air into the building. An air conditioning system improperly installed is sure to aid the spread of fire. An air conditioning system may be installed in such a manner as to affect the structural safety of a building, but I am sure no member of this Bureau would attempt such a thing. Therefore, I will deal with the second fundamental of building law—the prevention of spread of fire.

It has been thoroughly demonstrated over a period of years that unprotected horizontal and vertical openings in buildings of any type are the means of rapidly propagating a fire, or of panic caused by smoke which quickly permeates the whole building. Engineers and architects recognize the necessity for protecting such openings, but in the past few years, when a large amount of ductwork has been introduced into buildings to withdraw foul air, introduce fresh air, or remove odors from kitchen and other equipment, a new hazard has been created by the construction of vertical and horizontal duct systems. To some considerable extent this fire-panic hazard has been ignored, as such ductwork has to some degree been done without reference to the building departments.

Duct systems definitely connect floor to floor, or one portion of a building to another portion, so that if fire or smoke occurs in one part, it may be transmitted to the other parts. These outstanding fire hazards present themselves in connection with air conditioning systems as follows: use of combustible material in duct systems, or machinery and equipment housings; fire or smoke from the exterior being drawn into a building through a duct system, and overheating or overloading electrical equipment. In one case a loss of $50,000 was caused to a Los Angeles building through use of a wood fiber for insulating for soundproofing the ducts. Because the fire was in an enclosed duct it was inaccessible, causing a large smoke and water damage.

We must look to a remedy for the defects discovered that have caused fires in certain air conditioning systems, and I submit some suggestions, which, while they will improve conditions, are not to be considered as a complete remedy:

1.—Construct all ducts of fire-resisting material throughout, and see that they are insulated on the outside with incombustible material.

2.—Protect outlets and inlets of duct systems with automatic dampers and fusible links.

3.—Protect horizontal ducts at cross fire walls with automatic dampers and fusible links, so constructed that if part of the ducts were destroyed the cutoff at the fire wall would remain intact.

4.—Protect the fresh air inlets with wire screening to prevent burning embers gaining access to the duct systems.

5.—Protect fresh air inlet with automatic damper.

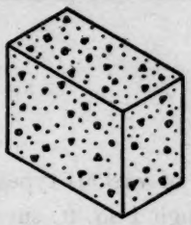
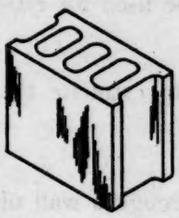
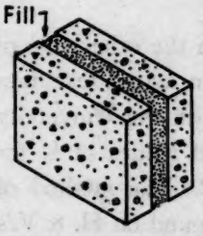
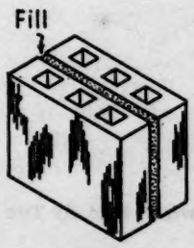
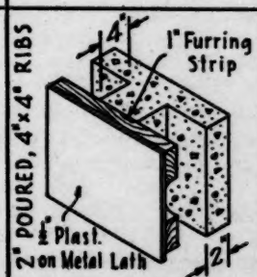
6.—Provide automatic dampers close to and in front of motors so that fire originating in this locality will be prevented from passing into the duct system.

7.—Make all ducts and machinery easily accessible to allow cleaning and repairing as may be required.

It is also advisable to provide remote controls in convenient locations for all electrical equipment in order quickly to stop the system from operating in case of fire, as the inrush of air from a vent duct would increase the fire's intensity, while an outlet duct in operation would tend to draw the fire into the duct and the heat in the duct would affect the construction of the building if the ducts were not properly fireproofed. There should be thorough periodic cleaning of ducts utilized for carrying odors from kitchen ranges such as are used in hotels and restaurants, for they collect grease and a flash of fire sometimes ignites them, with the whole duct system taking fire. High pressure steam jets should be installed in these ducts, with valves at convenient points for operation.—*Abstracted from an address by Edward W. Roemer, Boston Building Commissioner, before the Air Conditioning Bureau of Boston.*

HEAT TRANSMISSION TABLES

(Values of U for Concrete Walls)

CONCRETE WALLS — Figures are in B.t.u. per hour per square foot per degree temperature difference, air to air, still air inside, 15 m.p.h. wind outside.						INSULATING FILL				
CONSTRUCTION No.	← WALL TYPE	← AGGREGATES COMPOSED OF	TOTAL WALL THICKNESS, IN.	Exterior Finish	Interior Finish	None	Cinders	Cork	Rock Wool	Thickness of Fill Space, In.
131	POURED CONCRETE 	Sand and Limestone	4	Natural	Natural	0.87	–	–	–	–
132		Sand and Gravel	4			0.89	–	–	–	–
133		Cinder	4			0.68	–	–	–	–
134		Haydite	4			0.54	–	–	–	–
135		Sand and Cinder	4			0.80	–	–	–	–
136	CONCRETE BLOCKS 	Cinder	8	Natural	Natural	0.40	–	–	–	–
137					½" Plaster Appl. Direct	–	–	–	0.21	4¾
138				White Paint	Natural	0.37	0.28	0.20	0.21	4¾
139					½" Plast. on Metal Lath Furred	–	–	–	0.17	4¾
140				½" Plast. Appl. Direct	½" Ins. Bd Furred 1"	–	–	–	0.15	4¾
141			12	Natural	Natural	0.37	–	–	–	–
142		Haydite	8	Natural	Natural	0.36	–	–	–	–
143				White Paint		0.33	–	–	–	–
144		Sand and Gravel	8	Natural	Natural	0.52	–	–	–	–
145				White Paint		0.51	–	–	–	–
146			12	Natural	Natural	0.48	–	–	–	–
147		Cinder Part. Tile	4	Natural	Natural	0.56	–	–	–	–
148	DOUBLE 4" POURED CONC 	Sand and Gravel	10½	Natural	Natural	0.43	0.38	–	0.15	2½
149	DOUBLE 4" CONC. BLOCKS 	Cinder Partition Tile	9	Natural	Natural	0.28	–	–	0.18	1
150	2" POURED, 4"×4" RIBS 	Sand and Gravel	7½	Natural	½" Plaster on Metal Lath Furred 1" on Ribs	0.45	–	–	0.13	5

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HEAT TRANSMISSION TABLES

(Values of U for Concrete Walls)

The table on the other side of this sheet gives the values of U of various types of concrete walls. U is the amount of heat in B.t.u. passing through 1 sq. ft. surface of wall in 1 hr. when there is a 1° difference in air temperature between the inside and the outside of the wall, with still air on the inside and a 15 m.p.h. wind on the outside. Thus, the coefficients shown in the table cannot be used for estimating the heat flow through interior concrete walls.

The value of U is for substitution in the following formula to estimate the amount of heat transmitted through a wall:

$$H = A\,U\,(t_i - t_o)$$

where H is the total amount of heat in B.t.u. per hour passing through a wall of area A. The temperature of the indoor air is represented by t_i and that of the outdoor air by t_o. Data for the selection of these indoor and outdoor design temperatures are given on H. & V.'s Reference Data 57 and 58.

It should be noted here that the values of U which appear on the other side of this sheet have not been calculated but have been obtained from actual test data from research work sponsored by the ASHVE in cooperation with the University of Minnesota and the Portland Cement Association. Calculated values of U for concrete walls appear on H. & V.'s Reference Data 71 and 72. The method of calculating the values of U from heat conductivity data can be found on H. & V.'s Reference Data 69 and 70.

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H. & V's REFERENCE DATA—82

EDITORIALS

A Month of Meetings

June is the month of brides and roses to some but to many men in our industry, including your editors, it is a period given over to hastily moving from one meeting to another. Each year the meetings really get under way during the last few days of May and continue practically to the first of July. During the period several contractor organizations, two utility associations, two engineering groups, and innumerable manufacturer associations meet and the air rings with discussion of their problems, of their plans, and of their achievements. There is little doubt but that those who attend get certain tangibles out of the sessions as well as some intangibles including friendship and acquaintanceship.

For every one who attends these meetings, however, there are at least a dozen who do not get to go for one reason or another. To them the printed report of what happened and the printed summary of the information made available are the means of keeping in touch. Our aim to bring the printed story of events to these stay-at-homes accounts for the space and attention devoted to these meetings each year in our July issue.

This year not only have the meetings been as numerous as ever but increased business has brought about extended programs and many new problems and generally increased attendances. Summaries of the principal events of interest at the St. Louis meeting of Edison Electric Institute, and of the Grand Rapids meeting of the National District Heating Association are included. So also is attention given to the meeting of the two engineering groups and the warm air heating association. In the main, attention at this time has had to be confined to the events themselves leaving much of the detailed information in the form of papers to be included in later issues.

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Air Conditioning Estimates by Code

Elsewhere we print in full the application code for air conditioning as put out by the association of equipment manufacturers. It is offered by them as a guide for their own members and those who apply equipment of their manufacture. It is said to represent minimum standards only and is issued subject to some implied changes and amendments to be offered later. We believe that this code should be read carefully and thoughtfully by everyone who is concerned with making the estimates for applying air conditioning equipment.

Even a casual reading will call attention to the detail in which methods are specified and the extent to which data are introduced for use in preparing the estimates. So far as we can recall no similar code has gone to such great lengths. Moreover, a considerable part of the data quoted are different from the data which have been much used in the past for preparing these estimates. In short, the code is more specific and also more complete than similar compilations heretofore have been. At the same time it introduces some innovations.

We are not now prepared to comment at length or in detail on the various sections of the code. Much less are we prepared to predict how generally this code method will be accepted, how widely it will be used, or to what extent it may be amended as time goes on. We are prepared to state that it is worth thoughtful attention, and that so far as we can see it represents a step in the right direction. There has been altogether too little uniformity in preparing estimates on which to size equipment for both summer and winter work. The result has too often been the spectacle of so-called experts disagreeing so sharply and so vehemently as to discredit each other and the industry as a whole. There must be less of that kind of thing. One way to start is to have all making use of the same basic data and all following the same basic method of estimating.

We do not know how far this particular code will go toward setting up such a uniform practice but we do believe that eventually there must be a "one best method" of procedure, and that it must be widely accepted as such.

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Improved Coals for Stoker Use

The unit stoker is coming fast. We have repeatedly taken note of its astonishing rush in the past year or two. There is every indication that this year will see twice as many stokers put in to furnish a combustion device for heating plants as were installed last year. Much of this remarkable increase can be attributed to the solution of technical problems.

Among these problems, especially in the case of bituminous coal, have been those of suitably prepared and suitably delivered grades of coal. Originally, the stokers had to handle whatever fuel grades were available. Gradually, though, as the importance of the market and the necessity of providing good stoker fuels became better appreciated, improved products began to appear. Now there are available coal supplies prepared especially for stoker use and which take into account the characteristics of the stoker.

There is still much to be done and much which can be done to improve fuels for stoker use. If the experience of the oil fuel interests means anything there will eventually be a small number of well standardized and easily recognized coals made available widely. Things have not reached that happy state yet but bituminous for stoker use is well on the way toward demonstrating again that when the demand for any commodity becomes specific and pressing, means are found for satisfying it.

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Applications of Controls

For the past several months we have presented a series of diagrammatic sketches to illustrate some of the uses of automatic control when applied to heating or cooling installations where a fan is used. Finding it impossible to illustrate all such applications we have confined the diagrams to certain common cases only, and have aimed to include a reasonably good variety of cases. In this issue we show some of the applications to residential installations. Increased use of automatic control on residence jobs constitutes one of the striking shifts which have gone so far toward transforming practice in residential heating and cooling in recent years. The diagrams serve to illustrate how control of fans operates to secure control of the air temperature and humidity both where there is radiator heating and where there are no direct radiators.

While the diagrams in this issue complete the immediate series it is hoped that additional ones may be added later, for the subject of automatic control is always of interest and ingenious methods of securing such control are continually coming up. Ability of control equipment to save its cost in reasonable time is now so well demonstrated that these controls have taken their place as an essential part of every installation.

ABSTRACTS of Current Papers, Books and Pamphlets

National Electrical Code Handbook

The provisions of the National Electrical Code should be familiar to every engineer and contractor dealing with the installation of electrical equipment. This code is made up of the regulations of the National Board of Fire Underwriters for electric wiring and apparatus. It has been accepted as an American standard by the American Standards Association and serves as the basis of laws covering the installation of electrical equipment in most municipalities.

The purpose of this book according to the author is to enable the reader to grasp readily the general plan, scope, and intent of the National Electrical Code requirements, to present more or less detailed discussions of the rules wherever anything of practical value can be contributed by such discussion, and to make practical applications of the rules clear and easily understood. While this book does include everything that appears in the code, it is not a word-for-word reprint of the code rules.

The author has, in compiling this book, considerably rearranged the contents of the National Electrical Code, in order to aid the reader in acquiring a comprehensive grasp of the code requirements. He has so grouped the rules that all requirements on one subject appear in the same section and where a rule applies in a number of different cases, he has not hesitated to repeat the rule.

The book is divided into five parts. The first part is made up of a group of definitions of the terms used in the code; the second takes up the rules specifying the types of wiring approved under given conditions; the third part takes up the requirements pertaining to standard materials and apparatus and to the standard methods of installing such materials and apparatus; part four deals with the general rules applying to all wiring systems. In every wiring installation it is necessary to comply with certain requirements which are quite separate and distinct from the rules covering the type of wiring in the construction and installation of materials. This classification includes rules for service, grounding, automatic undercurrent production and wiring installation design. The fifth part takes up special cases. There are certain special cases in which certain special requirements must be applied, and in the interest of simplicity and clearness it was thought best to segregate these requirements from the main body of rules.

In the last part of this book is incorporated a new feature which should add materially to the practical value of the book. All the tables in the code containing data have been brought together in the last chapter, thus making them available for instant reference. A complete cross-section index for finding a section of the book corresponding to any given code paragraph is included in the book. There is also a subject index.

This is the third edition of this book and is based on the 1935 edition of the National Electrical Code.

[*"National Electrical Code Handbook," third edition, by Arthur L. Abbott. Published by McGraw-Hill Book Co., New York. Flexible binding, 5 x 7 1/2 in., 547 pages; price, $3.00.*]

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Commercial Refrigeration

Although this book is devoted mainly to the commercial application of refrigeration such as is found in the dairy, bakery, and meat shop, it does contain a considerable amount of material of interest to air conditioning contractors and engineers. The book is essentially practical, dealing with data obtained from the actual installations rather than from theoretical data and calculations. In the preface the author states that he has endeavored to present material as devoid as possible from lengthy calculations and has based it on actual installations rather than upon mere theoretical hypothesis.

Of special interest is the chapter on small unit installations as are also the chapters on methyl chloride, sulphur dioxide, and Freon units. In the discussion on small unit installations the author covers a number of interesting points including the selection of the proper type of foundations, method of isolating units, and selection of types of compressors, refrigerants, condensers, and motors. A large amount of miscellaneous data which are often difficult to locate can be found in the chapters on methyl chloride, sulphur dioxide, and Freon.

There is also a chapter on the treating and cooling of air. Although in most cases the data presented are rather elementary, there are some tables in this section which should prove of value to the engineer and contractor. Persons interested in the installation of cooling and air conditioning equipment in such industrial installations as bakeries, dairies, ice cream manufacturing plants, etc., will find a considerable amount of data in the chapters devoted to these subjects.

[*"Commercial Refrigeration—Small Plants," by L. Kay Wright. Published by Nickerson & Collins Co., Chicago. Cloth bound, 6 x 9 in., 406 pages; price, $3.50, post-paid.*]

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Standards for Rotating Electrical Machinery

The American Standards Association recently approved and published in a single volume new and revised requirements for nearly all the rotating electrical machinery manufactured and used in the United States. The volume lists standard requirements and specifications for electrical machinery from the large central station generators down to the small motors used on household appliances. Direct current, synchronous, and induction machines, synchronous converters and a.c. and d.c. fractional horsepower motors are covered.

The new standards offer the advantage of a limited variety of well chosen ratings and types from which a motor or generator suitable for practically any common purpose may be selected.

[*"American Standards for Rotating Electrical Machinery." Published by American Standards Association, 29 West 39 St., New York. Heavy paper cover, 8 x 10 1/2 in.; 97 pages; price, $1.30.*]

•

How To Figure Air Conditioning

This book is an outline of a method of figuring cooling requirements for buildings. It is divided into nine parts and each section of the calculations is treated in a separate chapter.

After a rather lengthy introduction in which the author takes up the definitions of the various terms used in air conditioning and discusses the general factors of summer cooling, he presents the first step in determining the cooling load. This is the calculation of the sensible heat gain taking into account the effect of sun on the walls and roof, the infiltered air, the heat given off by occupants, and the heat from electrical appliances. Each of these subjects is discussed and a number of tables are presented so that the load from each factor can be clearly defined. At the end of this chapter the author works out an example illustrat-

(Concluded on page 81)

NEWS OF THE MONTH

Radiator Heat Campaign to be Continued Vigorously

PHILADELPHIA—Plans for a vigorous continuation of the campaign for the promotion of air conditioning with radiator heat were made at the first meeting of the board of directors of the newly-incorporated National Bureau of Heating and Air Conditioning here May 26. A nationwide interest in the campaign, which was originally launched in Chicago some months ago, is indicated.

J. Lawrence DeNeille, St. Louis, was elected president of the Bureau, and Marshall Adams, sales promotion manager, American Radiator Co., was elected vice-president. Joseph C. Fitts, secretary of the Heating, Piping, and Air Conditioning Contractors National Association, was elected secretary-treasurer.

The Bureau was incorporated under the laws of New York State. The incorporators are Mr. Fitts, Mr. Adams; Martin Weil, vice-president, Weil-McLain Co.; Guy Hutchinson, vice-president, Hoffman Specialty Co.; and Russell G. Creviston, director of advertising and sales promotion, Crane Co. The directors are R. D. Berry, Gallaher & Speck, Inc., Chicago; Harry N. Booth, vice-president, sales department, U. S. Radiator Corp., Detroit; J. Lawrence NeNeille, Eichler Heating Co., St. Louis; Charles K. Foster, executive vice-president, American Radiator Co., Chicago; Charles V. Haynes, vice-president, Hoffman Specialty Co., New York; P. R. Mork, vice-president, Crane Co., Chicago; Martin Weil, Weil-McLain Co., Chicago; Louis T. Braun, executive secretary, Chicago Master Steamfitters' Association, Chicago; Russell G. Creviston, director, advertising and sales promotion, Crane Co., Chicago; Samuel L. Haas, Advance Heating Co., Inc., Chicago; A. R. Herske, vice-president and general manager of sales, American Radiator Co., New York; James C. Matchett, vice-president, Illinois Engineering Co., Chicago; C. G. Newton, Stevens-Root Co., Chicago; Norman J. Radder, secretary, Plumbing and Heating Industries Bureau, Chicago; and John H. Zink, Heat & Power Corp., Baltimore.

Boston A.C. Up

BOSTON—Air conditioning installations in Boston metropolitan territory have taken a big jump in the last six months, a total of 41 being listed up to May 28. The local utility reports that in 1936 it has added 903½ hp. to its air conditioning load up to April 1, and the month of May brought the figure to an even thousand.

Warranty Adopted by ACMA

HOT SPRINGS, VA.—At the annual meeting of the Air Conditioning Manufacturers' Association recently held here, a standard form of warranty was adopted and recommended for the use of members. This warranty reads:

"Seller shall repair or replace, at its option, free of charge, f.o.b. the place of manufacture, any part of the within equipment manufactured by it that is claimed to be defective in workmanship or material, within one (1) year from date of shipment and, upon inspection, is proved to the satisfaction of Seller to have been defective at the time of shipment provided that Buyer promptly gives Seller notice and full information in writing about the defects and delivers the part f.o.b. Seller's factory for inspection, when requested. Equipment manufactured or supplied by others, but furnished by Seller under this order, carries the same warranty to Buyer that the manufacturer or supplier thereof furnishes to Seller. Seller shall not be liable for repairs or replacements made by Buyer without its written consent, nor for damages, delays and losses, consequential or otherwise, caused by defects, its liability being expressly limited to repair or replacement, as stated herein."

A.C. Active in Birmingham

BIRMINGHAM, ALA.—A revival of interest in air conditioning resulted in Birmingham during May, reports Leo V. Fried, secretary-manager of the Birmingham Air Conditioning Bureau. Installations have just been made in the Five Points Theater, first neighborhood theater to be air conditioned, in the Parisian Department Store, in men's wear store of J. Blach & Sons, and in Silver's five-and-ten-cent store. Contracts have been awarded for one floor of the Tutwiler Hotel, for the dining room of the Molton Hotel, and for the Empire Steak House.

Contractors Join A.C. Council

KANSAS CITY, MO.—To further standardize the air conditioning industry in this city, the leading sheet metal, electrical, and heating and piping contractors are now included in the membership of the Air Conditioning Council of Kansas City, Mo.

This is another step in assuring all purchasers of air conditioning in the Kansas City territory, who deal with members of the Council, that installation will be made on the proper engineering basis and in conformity with the standards of the Council.

15,000 Dealers to Sponsor Air Conditioning Week

CHICAGO, ILL.—Over 15,000 warm air heating and air conditioning dealers and contractors throughout the United States, in connection with furnace and air conditioning manufacturers, are sponsoring a nationwide movement to set aside the week of August 17-22 as National Warm Air Heating and Air Conditioning Week.

The movement was put into motion on June 20 following the general announcement made by the manufacturers of warm air heating and air conditioning equipment at their national convention held in Columbus, Ohio, on June 16-17-18.

This nationwide movement includes complete educational activities on the parts of the manufacturers, dealers, and contractors, to clear up in the minds of the present and potential users of warm air heating and air conditioning, winter and summer, alleged confusing statements and claims being made in national advertising and sales literature. This educational plan covers the proper and true definition of air conditioning, its proper functions, and its correct installation.

ASHVE Chapter Formed

MONTREAL, QUE.—This city now has an ASHVE chapter as the result of an organization meeting held in the Queen's Hotel recently, and attended by seventy-five members of the plumbing and heating industry.

G. L. Wiggs was elected president; F. J. Friedman, vice-president; C. W. Johnston, secretary, and F. G. Phipps, treasurer.

The chapter will receive its charter on October 18.

Boston A.C. Bureau Meets

BOSTON—Members of the Air Conditioning Bureau held their regular monthly meeting June 18, at the Edison Auditorium, joining with the American Society of Refrigerating Engineers and the National Association of Practical Refrigerating Engineers. About 125 were present to hear the guest speaker, F. A. Weisenbach, eastern regional manager, York Ice Machinery Co. Among the engineers present were F. A. Shippey, president, W. D. Pierce, vice-president, and Herman R. Smith, secretary-treasurer, of the National Association of Practical Refrigerating Engineers.

Mr. Weisenbach gave an interesting talk, illustrated by lantern slides, on various air conditioning installations of national interest.

Booklet on A.C. Published by Dealers

SPRINGFIELD, MASS.—The Air Conditioning Bureau, an organization made up of dealers of this city handling air conditioning equipment, has published a 16-page booklet on "Air Conditioning in Springfield and Vicinity." The purpose of this booklet as stated in the publication "is to give a review, not only of typical air conditioning installations in Springfield and vicinity, but also to present an unbiased summary of what air conditioning is, and why it is of vital importance."

The book opens with a description of air conditioning and an explanation of its values. By use of illustrations and statements several facts about the air we breathe are given.

From there the book goes on to a summary of what air conditioning does and applications in Springfield and vicinity. Pictures of clubs, banks, factories, stores, hotels, restaurants and cafes, industrial establishments and homes in Springfield and vicinity where air conditioning has been installed, are published. In the back of the book the 12 members of the Air Conditioning Bureau are listed along with their addresses and telephone numbers and the make of equipment that they handle.

These booklets were distributed to homes and business establishments in Springfield and neighboring towns.

Propose Canadian Section for Guide

TORONTO—The annual meeting of the Ontario Chapter, ASHVE, was held in the Royal York Hotel May 4. Reports of the various committee chairmen were enthusiastically received.

Officers for the coming year are: president, Tom McDonald, Minneapolis-Honeywell Regulator Co.; vice-president, G. E. Playfair; board of governors, J. W. O'Neill, H. D. Henion, and H. B. Jenney; secretary-treasurer, H. R. Roth.

One of the features of the gathering was the discussion of the possibility of including a Canadian section in the society's publication, the *Guide*.

Michigan Chapter Elects Officers

DETROIT, MICH.—The May meeting of the Detroit Chapter, ASHVE, was held at the Meadowbrooks Country Club. New officers were elected for the year as follows: President, R. K. Milward; vice-president, Frank J. Feely; secretary, G. H. Tuttle; treasurer, A. P. Darlington.

In the golf tournament conducted during the afternoon H. M. Armstrong was declared the winner with the lowest gross score.

A.C. Plant for U. of Illinois Students

URBANA, ILL.—The largest installation of a summer and winter central air conditioning plant for instructional purposes is being built in the department of mechanical engineering of the University of Illinois and will be ready for use by classes entering next fall. The system will have a capacity of 3000 c.f.m., with refrigeration provided by a 14-ton compressor. It will have dry filters, tempering coils, air washer humidifier, and heating coils. Heat transfer for cooling can be carried on in any of three ways: by direct expansion cooling coils, by surface water coolers, and by use of the air washer.

The plant will be covered with 2 in. of cork insulation, from the filters to the distributing ducts. Venturi sections are provided in the air inlet from the outside; in the duct for recirculation, and in the air supply duct to the conditioned space. Temperatures will be measured by thermo-couples. Dampers will be manually controlled but are designed for automatic control at a later date.

The plant will be used for instructional work by seniors and graduate students.

Frick Honored by RMA

HOT SPRINGS, VA.—Ezra Frick, president of Frick Co., Inc., Waynesboro, Pa., was elected an honorary member by the Refrigerating Machinery Association in its spring meeting here May 15. In proposing the resolution conveying this honor to Mr. Frick, W. S. Shipley, president of York Ice Machinery Corp., told of the valuable contributions which Mr. Frick had made to the Refrigerating Machinery Industry and the Association during the past forty years and of the affection and esteem in which Mr. Frick is held by members of the industry.

Mr. Frick has been active in the field of steam engineering and refrigeration since the early seventies. His career with the Frick Co. started in 1875, when he entered the company's employ as a machinist's apprentice. Mr. Frick's rise was rapid and he became general manager of the company in 1898, in which capacity he served for over thirty years. He has been president of the company since 1924.

26 Graduated in A.C. Course

BOSTON—Lowell Institute School graduated 26 students in air conditioning May 27, in a total engineering class of 338, the largest in the Institute's history. President Emeritus Dr. A. Lawrence Lowell of Harvard University presided and presented the certificates.

Westinghouse Host to Editors at Springfield

SPRINGFIELD, MASS. — Announcement and preview of new Westinghouse air conditioning equipment, together with a trip through the newly-equipped factory for its production drew editors of prominent business and technical papers here June 17.

That Westinghouse is in the air conditioning equipment business in earnest is evidenced by the money invested in research and experimental laboratories and plant equipment for the new line of hermetically sealed condensing units. Location of the manufacturing and engineering activities at the Springfield plant brings all the manufacturing and engineering in connection with refrigeration into one place. A feature of especial interest in the newly-rearranged factory space is the use of a glass enclosure for assembling equipment. This room is air conditioned with cooling furnished by one of the company's compressor units.

Refrigeration compressors, with water jacketed electric motor cast integral with the compressor and with weights and dimensions greatly reduced, are being made with 2, 4, and 6 cylinders in line, and carrying horsepower ratings of 7½, 15, and 25, respectively. All the sizes are so designed that many of the parts are interchangeable, thus eliminating a great deal of complication in factory production as well as greatly simplifying repair and maintenance work in the field. Lubrication to all bearings is forced by a gear type pump located inside the crank case, and an outstanding feature of the compressor design is the absence of any stuffing box, as the entire mechanism is fully enclosed. Condensers are of a nested copper coil type shell and tube. An ingenious arrangement permits changing the amount of active condenser surface with changes in condenser water pressure.

In connection with the view of 40,000 sq. ft. of floor space being used for the manufacture of the new equipment, the editors enjoyed a short skit put on by S. F. Myers, manager of air conditioning sales, and E. R. Wolfert, of the air conditioning engineering division, in which reasons for the principal features of the design were brought out. It was announced that sales activities of the air conditioning division will continue to be located at the Westinghouse plant at Mansfield, Ohio.

Merle Heads Consulting Firm

NEW YORK—André Merle Associates is the name of a new consulting firm formed here to specialize in the drafting of plans and specifications, engineering surveys and cost analysis work on air conditioning, heating, ventilating, and commercial refrigeration. The firm is located at 11 East 44 St.

Cleveland Meeting Features Residential A.C.

CLEVELAND—Chester A. Thompson, building contractor, was the first speaker at the open meeting on residential air conditioning at the April 14 meeting of the local chapter, ASHVE.

He was followed by E. P. Farris who spoke on distribution of air and emphasized the importance of proper air motion in the home. Mr. Farris commented on the good practice procedure followed by the Central Bureau for Heating and Air Conditioning which designed ducts on the friction loss basis with 300-350 f.p.m. velocity at the register face, 500 f.p.m. in the risers, and 1,000 f.p.m. in the main trunks. He recommended that the air temperature at the register be 150F in zero weather.

F. R. Dickinson presented a paper describing the present forms of winter air conditioning, following which he outlined the requirements for summer air conditioning.

C. E. Hansen spoke on the importance of economy in first cost, operation and maintenance in large residential air conditioning systems.

Friez Co. 60 Years Old

BALTIMORE—Julien P. Friez & Sons, Inc., maker of weather instruments and controls, celebrated its 60th year in business June 1. The company was founded in 1876 by Julien P. Friez.

The occasion was celebrated by a picnic attended by all factory and office employes at Crystal Beach, Md. A presentation was made by the employes to Lucien L. Friez, son of the founder and present president. The presentation was a bronze plaque of Julien P. Friez.

50 A.C. Cars for New Haven

BOSTON—Anticipating a traffic increase as a result of the reduction in railroad passenger rates to two cents a mile, the New Haven has placed an order for 50 more streamlined air conditioned passenger cars, and 10 new high power locomotives. During the summer of 1936 the road will have a total of 613 air conditioned cars in operation for passenger service.

Beling Forms Company

MOLINE, ILL.—Earl H. Beling, well known through the industry as manager of the unit ventilator division of The Herman Nelson Corp., announces the formation of the Beling Engineering Co. The new company, which will be headed by Mr. Beling, plans to conduct a contracting business, specializing in school installations. Headquarters are at 2428—13 St., here.

A.C. Apartment for Chicago

CHICAGO—The first air conditioned apartment building in this city is planned for early erection according to announcement by the owners. This $100,000 project will not only be the first multiple unit structure erected in a number of years in the Gold Coast section but will utilize new developments in construction.

The structure will include 16 two-story duplex studio suites, eight to each floor, making the building equivalent to a four-story apartment building in height and will be constructed of steel, structural glass blocks, brick and concrete. Ralph Renwick, local contractor, has been awarded the general contract. Completion of the building is scheduled for fall.

Stoker Manufacturers Elect Goddard President

WHITE SULPHUR SPRINGS, W. VA.—At the convention of the National Association of Stoker Manufacturers, held here June 11-13, R. C. Goddard was elected president. Mr. Goddard, a pioneer in the stoker business, is vice-president of The Steel Products Engineering Co., Springfield, Ohio, in charge of the Combustioneer Division. He is a past president of the Midwest Stoker Association.

Chicago's Building Code Submitted

CHICAGO—Following nine years of preparation the building code commission on May 19 submitted a new city code to a subcommittee of the council committee on building and zoning. The new code is in 50 sections comprising 1,812 pages containing 360,000 words, with a digest of more than 70 pages. The subcommittee chairman said that it would require a thousand hours to read it before the subcommittee could begin discussion.

Delco-Frigidaire Appoints Bauer

HARTFORD, CONN.—Bauer & Co., 440 Asylum St., has announced its appointment as distributor for Delco-Frigidaire air conditioning and automatic heating equipment. The firm announces that all types of heating and air conditioning installations will be handled, regardless of size, and that 24-hr. service will be maintained.

A.C. for Medieval Hall

MUNICH, GERMANY—The historic City Hall of Munich, constructed during the middle ages, has now been air conditioned to preserve the Gothic hall with its magnificent carved wood ceiling.

Toronto Chapter Elects McDonald

TORONTO, ONT.—The feature of the May meeting of the ASHVE Ontario Chapter, held in the Royal York Hotel, was the election of officers and the reading of reports from committees.

Thomas McDonald was elected president, and G. E. Playfair, vice-president. H. B. Jenney, H. D. Henion, and J. W. O'Neill were chosen as board of governors, while Harry R. Roth, secretary-treasurer, will continue in office. The retiring president, M. W. Shears, was thanked for the valuable work he had accomplished during his term of office.

Belmont Wins Cup

CHICAGO—The 10th annual oil burner industry golf tournament, sponsored by the Chicago Oil Burner Association, was played over the Mohawk Country Club course June 19. Frank Belmont, Braun Bros. Oil Co., with a low net score of 74, won the Risher Cup, and will be the tenth person to have his name engraved on the cup. Runner-up prize was won by J. J. Kristufeh, John L. Herman Co., and the low gross prize was won by D. C. Nicol, John Wood Mfg. Co.

Fur Storage Rooms Conditioned

JACKSON, MISS.—The Harwell Appliance Co. of this city has air conditioned the new fur storage room of the Jackson Steam Laundry. A constant temperature of about 40F is maintained during the storage season by means of automatic thermostatic control. Space is provided for over 2,000 garments.

Opens New Haven Office

NEW HAVEN, CONN.—A district sales and service office has been opened at 30 Whitney Ave., this city, by Minneapolis-Honeywell Regulator Co., to serve the southern Connecticut area. George R. Chamberlin will be in charge of district operations.

G. E. Licensed

NEW YORK—General Electric Co. has completed arrangements with the Auditorium Conditioning Corp. whereby it is privileged to use the various patents controlled by the Auditorium Conditioning Corp.

Padou Addresses Bureau

SPRINGFIELD, MASS.—The Air Conditioning Bureau of Springfield held its monthly meeting May 27 at the Building of Electrical Progress. The speaker, A. V. Padou, zone manager of Delco-Frigidaire Conditioning Corp., spoke on "Electric Room Coolers and Air Conditioning Equipment."

Drug Chain to Have A.C.

KANSAS CITY, MO.—The Katz Drug Co. is completing an extensive remodeling program of its stores in Greater Kansas City. Included in the program is the air conditioning of the following store locations: 12th St. and Baltimore Ave.; 12th and Walnut Sts.; 10th and Main Sts.; Minnesota Ave., Kansas City, Kan.

An alteration program, including air conditioning, will be carried out in a short time at the 12th and McGee St. store. A large store at Main St. and Westport Ave. was air conditioned early this spring.

Anti-Silicosis Laws Enacted

ALBANY, N. Y.—Three anti-silicosis bills were signed here by Governor Lehman on June 9. One of the bills makes an appropriation of $100,000 to enable the Industrial Commissioner to enforce the requirement that employers must use dust elimination devices approved by the Commissioner. The bills also authorize taking $50,000 annually beginning July 1 and continuing to June 30, 1941, from the state vocational rehabilitation fund to make studies of methods of preventing dust diseases and to devise methods for eliminating such hazards.

ASHVE and ASRE Hold Joint Session in Pennsylvania

(Concluded from page 52)

velopment of and classified various instruments for the measurement of total sun radiation. He then described tests which he conducted at Buffalo last summer using a calibrated blackened thin plate type pyrheliometer. He tested a pane of heat absorbing glass ⅜ in. thick and found that 77% of the total solar energy was absorbed and reflected so that only 23% was transmitted.

Building Heat Requirements

The actual heat input of a building is practically always at variance with the computed input and for the past several years there has been more and more agitation for more accurate determination of the heat requirements of buildings. For a number of years F. E. Giesecke, director of the Texas Engineering Experiment Station, has been interested in this subject and during the heating season of 1935-36 he and W. H. Badgett, a research assistant at the Station, made a field study of the heat requirements of a large building on the campus of Texas A. & M. College. These tests Professor Giesecke reported at the summer meeting.

Since the building is heated from a central hot water plant the heat input could be accurately measured, since it was no particular problem to meter the water flow and to take temperatures of the incoming and outgoing water. During the tests outdoor temperatures, indoor temperatures, and wind velocity were recorded and the heat requirements of the building computed following the procedure and recommendations in the 1935 Guide. Consequently, the heat requirements per degree-hour could be computed and the 24-hr. total determined.

Observations were all made on totally cloudy days to eliminate the effect of solar radiation. Neither was there any precipitation in any of the cases reported in the paper excepting a light snow on one morning.

On days when the sun was shining, the effect was immediately discernible in the rooms exposed to the sun. The temperature in those rooms rose rapidly to as much as 10F above that when the sun was not shining, while the temperature in the rooms on the shaded portion of the building remained normal. This clearly indicates that automatically controlled radiator circuits, zoned for the various exposures of a building, are desirable.

After these studies had been made and the per cent of variation between the estimated and the actual heat requirements of the building found to be approximately 23%, an additional check was made of the calculations used to estimate the heat requirements of the building. With a thickness gage, the cracks between the steel sash and the window frame were measured on a great number of windows of the building and found to be considerably smaller than those assumed. Consequently, the infiltration of air around the windows was corrected to conform more nearly with the actual crack in the windows. This correction reduced the total estimated heat requirement under design conditions to 1,271,700 B.t.u. per hr., or 28,900 B.t.u. per degree difference, indoor to outdoor temperature. Thus, the estimated heat requirements were reduced to 13.5, 18.3, 17.7, 10.5, 4.6, 17.3, and 6.5% higher than the actual heat requirement, or an average of 12.6% more estimated than required.

From this study it appears that the greatest source of error in making an estimate of the heat requirements of a building occurs in allowances made for air infiltration.

A paper on the same general subject as that of Professor Giesecke's was Heating Requirements of an Office Building as Affected by Weather Conditions, by F. C. Houghten and Carl Gutberlet, director and research assistant of the ASHVE Research Laboratory. These tests, made in the Grant Building, Pittsburgh, Pa., were run in eight rooms on three different floors and with three different exposures. The rooms were heated by an electrical unit so as to obtain a close measure of the heat input. The conclusions follow:

The study briefly indicates a considerable reduction in heating requirement of the rooms on upper floors below that required for rooms on lower floors due to the chimney effect of the building.

It is shown that the sun effect on the heating requirement of rooms subject to solar radiation is considerable and varies from no effect on cloudy days to a very large effect on days of more intense radiation. There is considerable lag between the time of maximum solar radiation effect and the resulting reduction in the heating load for any particular room. The percentage of solar radiation impinging against the glass of the window in a given room, which is effective in heating that room during the usual heating period of the day, varies considerably, but averages about 50%.

The relation between heating requirement and temperature difference between the inside and outside air is indicated to be a straight line relation, no heat being required when the outside temperature is above 65F for the lower floors of the building, and at a slightly lower temperature for rooms in the upper part of the building where infiltration is not a factor. Solar radiation reduces the outside temperature at which heating is required on sunny days.

For best conditions of control in rooms where solar radiation was not a factor during the test period, considerable variation in the heat requirement per degree temperature difference was observed which could not be accounted for by wind velocity or direction, or by precipitation.

Charles A. Gillham

NEW YORK—Charles A. Gillham, vice-president, general manager, and a director of the New York Steam Corp., died here suddenly on June 19. He was 62 years old.

Born in Mattoon, Ill., Mr. Gillham came to New York in 1914 to take charge of the reorganization of the then New York Steam Co., which had gone into receivership. In 1920 he completed this task and became vice-president and general manager of the New York Steam Corp., which evolved from the former company. He was later made a director.

Mr. Gillham was also vice-president of the U. S. Mineral Wool Co., and was at one time president of the Insulating Products Co., vice-president of Bellum Supply Co., and director of the Central States Engineering Co. and the American District Heating Co.

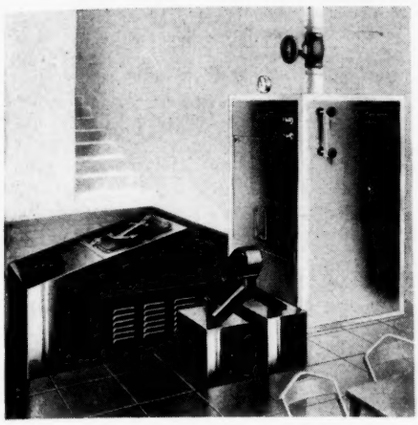
He is survived by his widow and a daughter.

NEW EQUIPMENT

Anchor Kolstoker

NAME—Anthracite-burning Kolstoker.

FEATURES—Furnished in standard type or with automatic ash removal. For use with any type heating system or with high pressure boiler. Other features include Oilmotor



drive; attractive cabinet, lined with soundproof insulation; feed worm inspection plate which makes it easy to remove obstacles from the coal feed mechanism; sectional burner head, said to permit expansion and contraction without cracking or warping; low hopper with large coal capacity, and safety of cabinet design, which completely encloses working parts.

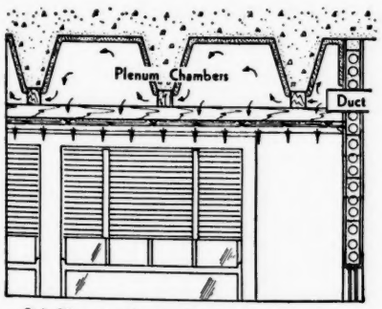
MADE BY — *Anchor Stove and Range Co., New Albany, Ind.*

Burgess Acousti-Vent

NAME—Burgess Acousti-Vent.

PURPOSE — Combined air inlet and sound deadening ceiling.

FEATURES—System comprises a perforated ceiling made of a suitable architectural surface installed slightly below the normal ceiling level of the room. Between the perforated sheet and room ceiling is a sound absorbing material that is installed with sufficient clearance so that a space is provided between the sound absorption material and the ceiling. This space serves as a plenum chamber into which air is introduced through ducts. Air flows uniformly through the perforated ceiling into all parts of the room.



Side Elevation Showing Plenum Chambers above Burgess Acousti-Vent Ceiling

Room noises, upon reaching the perforated metal ceiling, seep through the small perforations and encounter the resilient sound absorbing material. Sound waves are absorbed, causing a reduction in the noise level of the room.

MADE BY—*C. F. Burgess Laboratories, Inc., Chicago.*

Air Conditioning Coils

NAME AND MODEL NUMBER—Standard all-copper air conditioning coils, series 750.

PURPOSE—For heating or cooling air in air conditioning systems.

FEATURES — Manufacturer claims a permanent metal-to-metal contact between fin and tube obtained by hot tinning after fabrication and assembly, and the bond is said to assure a definite cooling rate which exceeds that of coils in use at the present time. It is also claimed that the metal dipping eliminates oxidation and since the coils remain cleaner they are said to have a higher operating efficiency.

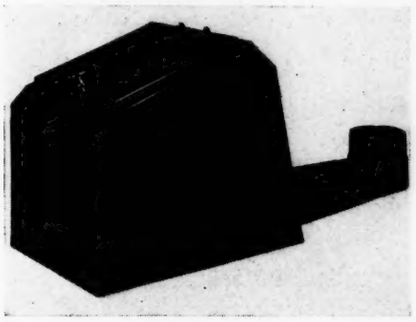
SIZES AND CAPACITIES—Face areas from 1 to 10 sq. ft. up to 12 rows deep. Capacities, at 85F dry bulb, 50% R.H., entering air 500 f.p.m. face velocity, from 6,000 B.t.u. per hr. and up. Coils also built to order for special installations.

MADE BY — *Standard Galvanizing Co., Air Conditioning Coil Div., 2613 W. Van Buren St., Chicago.*

Kelvinator Stoker

NAME—Kelvinator stoker.

FEATURES—Available in five models, two smallest being for small and medium sized residences, three largest for large residences, apartments, stores, etc. Of the underfeed screw type with controlled forced draft, stoker provides for complete combustion of all the fuel. Air is delivered to the full bed through a tuyere block. Transmission is of the agi-



tated type, equipped with five speeds. Safety features include limiting device to prevent overheating of the furnace or boiler, shear pin of soft steel to prevent harm to the mechanism in case metal or other foreign matter gets into fuel supply worm, and overload protection by means of automatic resetting overload switch.

SIZES AND CAPACITIES—Capacities range from 7 to 150 lb. of coal. Smallest size has a hopper capacity of 350 lb., while all other models have hopper capacities of 500 lb. Hoppers are constructed of 14 gage, welded, seamless copper bearing steel with cast iron base.

MADE BY—*Kelvinator Corp., Detroit, Mich.*

York Welding Flanges

NAME—Steel welding flanges.

PURPOSE—For welding refrigeration and air conditioning piping.

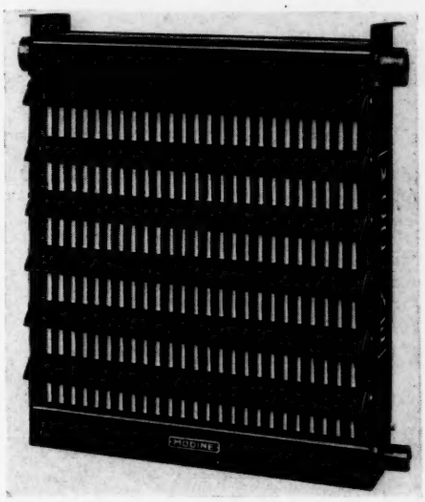
FEATURES—Made entirely of forged steel. Tongue and groove type. Have an extra long welding neck. Company has also designed pipe welding plugs for use as a fixture to hold flanges in line with the pipe. These are all of solid copper alloy.

MADE BY — *York Ice Machinery Co., York, Pa.*

Modine Unit Heaters

NAME AND MODEL NUMBER—620 and 1300 Modine unit heaters.

FEATURES—Model 620 developed to satisfy heating requirements too large for company's



model 542 and not great enough to meet required heat of model 710. Available with single, two- and three-speed motors. Model 1300 is the largest of the single condenser, single fan unit heater in the company's line and incorporates new design features as applied to single condenser units. Furnished with side tappings to save head room.

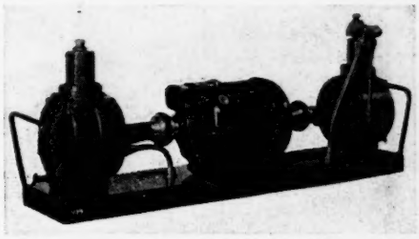
SIZES AND CAPACITIES — Model 620, 148,800 B.t.u. per hr. at 2 lb. steam and 60F entering air, replaces 620 sq. ft. of cast iron radiator. Model 1300, 312,000 B.t.u. per hr. at 2 lb. steam and 60F entering air, replaces 1300 sq. ft. of cast iron radiator.

MADE BY—*Modine Manufacturing Co., Racine, Wis.*

Beach-Russ Vacuum Pump

NAME—Beach-Russ vacuum pump.

PURPOSE—Used for evacuating refrigeration systems prior to introducing the refrigerant; for testing the tightness of refrigerating lines; also for testing for leaks when trouble has developed.



FEATURES—Portable unit with two vacuum pumps, both directly connected to one motor.

METHOD OF OPERATION — Both pumps may be operated in series to produce a vacuum within ½ mm. of absolute or in parallel to produce a vacuum within 1½ mm.

SIZES AND CAPACITIES—Two sizes available. One with a capacity of 1 c.f.m. (series) and 2 c.f.m. (parallel). Second unit 2 c.f.m. (series) and 4 c.f.m. (parallel).

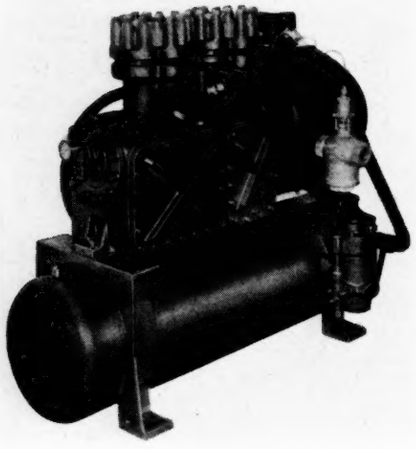
MADE BY—*Beach-Russ Co., 50 Church St., New York.*

Westinghouse Condensing Unit

NAME AND MODEL NUMBER—Westinghouse air conditioning condensing unit, type CLS.

PURPOSE—To supply cooling for air conditioning.

FEATURES—Consists of motor, compressor, and a combined condenser and refrigerant receiver. Motor and compressor are hermetically sealed. A water cooled generator and the compressor are mounted on a common crankshaft, and since they are made from a common casting, no shaft seal is required. A series parallel condenser manifold permits the use of either city water or a cooling tower. Mechanical adjustments are made through side service plates without disturbing either the unit itself or the refrigerant of water lines. Major parts of the unit are interchangeable. An oil pump supplies positive lubrication to all bearings.



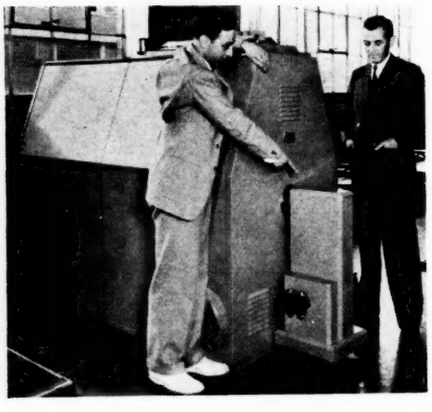
SIZES AND CAPACITIES—7 to 22 tons ice melting effect in 24 hr.

MADE BY—*Westinghouse Electric & Mfg. Co., Mansfield, Ohio.*

Gar Wood Model 102-A Unit

NAME AND MODEL NUMBER—Model 102-A Gar Wood Tempered-Aire unit.

PURPOSE—Oil fired air conditioner, warm air type, for average-sized and small homes.



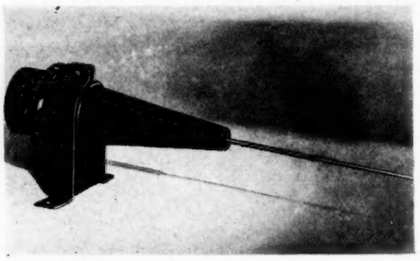
FEATURES—Contains features and mechanism found in the standard but higher priced model 102. Oil burner not enclosed but in same operating position as in model 102. Provides humidifying, filtering, and forced warm air circulation in winter, and circulation and filtering in the summer.

MADE BY—*Gar Wood Industries, Inc., Detroit, Mich.*

Brown Instrument Protectoglo

NAME—Protectoglo.

PURPOSE—Safety control for combustion safeguarding.



FEATURES—Electrode of heat resistant conducting material projects into the firebox so that flame impinges upon the electrode. Operation depends on electrical conductivity of the flame itself. Relays contain the thermionic tubes for rectification and amplification of the power input which, when conducted from the electrode unit to ground through the flame, operate the relay units controlling the operation sequence, main fuel valve, etc. Any interruption in the circuit to ground through the flame (flame failure) causes shut-down.

MADE BY—*The Brown Instrument Co., Philadelphia, Pa.*

York Vertical Air Conditioners

NAME—York vertical air conditioner.

FEATURES—Units are of vertical type and consist of casing, drip-pan, fan assembly, motor, heating and cooling coils, thermostatic expansion valves, liquid distributing header, humidifier and air filter of the sectional type. Variable pitch driving pulleys permit close adjustment to all fan speeds after unit has been installed.

SIZES AND CAPACITIES—Model FC-308, 3 tons refrigerating capacity; models F-608 and F-612, approximately 6 tons; models F-1508 and F-1512, approximately 15 tons; models F-3008, F-3012, and F-3016, 30 tons.

MADE BY—*York Ice Machinery Corp., York, Pa.*

Graham Steam Ejector

NAME—Graham water cooler.

FEATURES—Steam ejector coolers of both surface condenser type and barometric condenser type. Where steam at any pressure is available with condensing water from rivers, cooling towers or wells, chilled water can be produced economically at temperatures down to 35F. Surface type generally used with cooling tower and spray pond; barometric type requires a barometric leg of 34 ft. and is adaptable to outdoor installation. Surface condenser type has automatic water setting device, condensate level controller, and compact assembly. Barometric condenser type available in either single or multiple booster design and may also be automatically controlled.

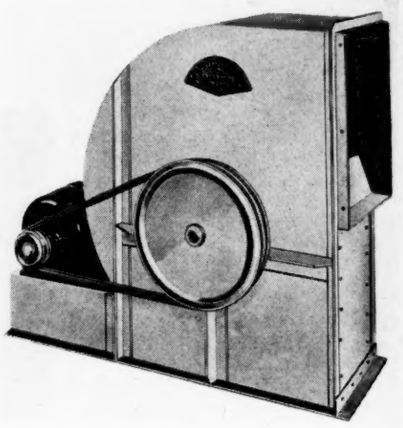
SIZES AND CAPACITIES—Surface condenser type in 12 standard frames for single booster type and eight standard frames for the double booster type with capacities ranging from 6 to 135 tons, depending on the steam pressure and chilled water temperature. Barometric type in frames with capacities ranging from 20 to 135 tons, depending on the steam pressure and chilled water temperatures.

MADE BY—*Graham Manufacturing Co., Inc., 220 Delaware Ave., Buffalo, N. Y.*

Autovent V-Belt Blower

NAME AND MODEL NUMBER—Autovent V-belt drive unit blower.

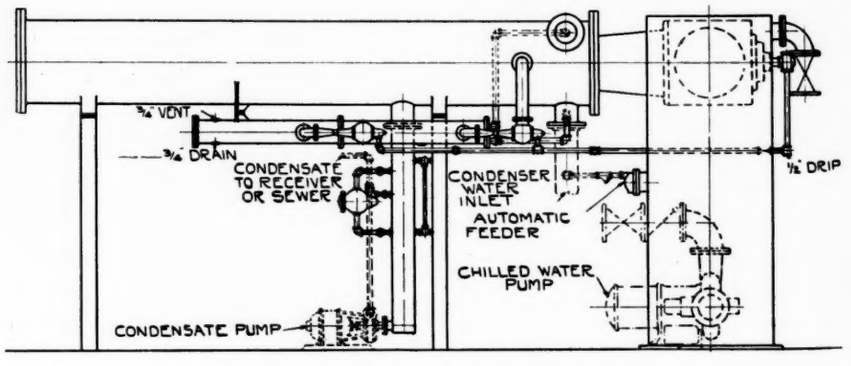
PURPOSE—To meet conditions where for various reasons a belt-driven blower is considered more desirable than a direct connected blower.



FEATURES—Has a uniblade type H blower. Is equipped with suitable V-belt drive operated by a standard frame motor. Motor is mounted on a steel pedestal base, built integral with blower housing. Manufacturer claims that standard motors operated at 1,750 r.p.m. are more efficient than slow speed motors furnished with direct connected blowers in order to conform to the blower speeds. V-belt drive makes it possible to interchange motors due to changing current characteristics or break-down.

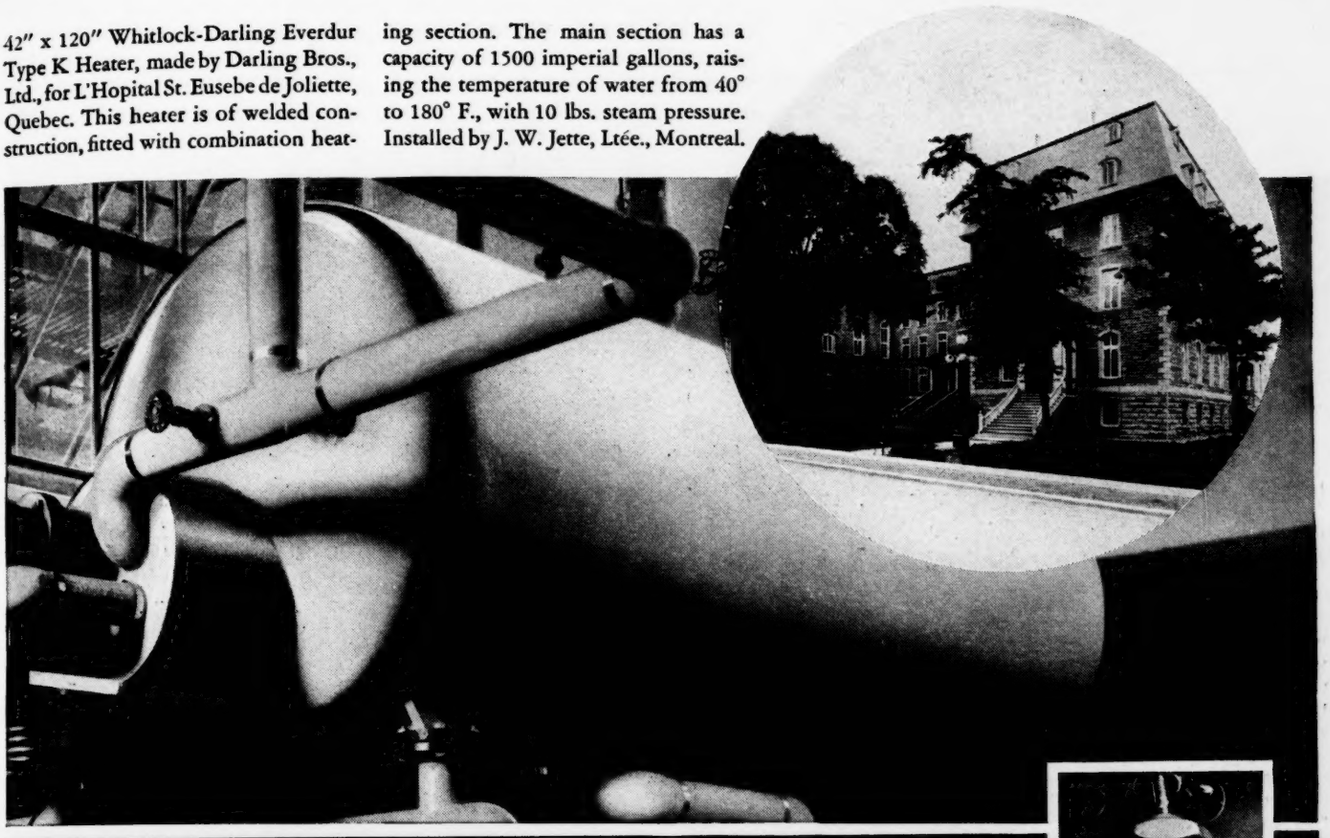
SIZE AND CAPACITIES—Five wheel diameters from 12½ to 25 in. Complete line covers range of capacities from 1,245 c.f.m. to 8,350 c.f.m. at ¼ in. static pressure or from 830 c.f.m. to 6,345 c.f.m. at 1 in. static pressure.

MADE BY—*Autovent Fan & Blower Co., 1805 N. Kostner Ave., Chicago, Ill.*



Graham single booster—condenser type

42" x 120" Whitlock-Darling Everdur Type K Heater, made by Darling Bros., Ltd., for L'Hopital St. Eusebe de Joliette, Quebec. This heater is of welded construction, fitted with combination heating section. The main section has a capacity of 1500 imperial gallons, raising the temperature of water from 40° to 180° F., with 10 lbs. steam pressure. Installed by J. W. Jette, Ltée., Montreal.



Canadian Hospital gets heater of non-rust EVERDUR METAL... (STRENGTHENED COPPER) and rust-free hot water is assured

Significant of the growing acceptance of storage heaters made of Everdur Metal is a recent installation in L'Hopital St. Eusebe de Joliette, Quebec, where clean hot water is not merely a convenience but a vital necessity.

For this...and other institutions...the choice of an Everdur Metal heater is both logical and economical. For in addition to assuring a plentiful supply of clean, *rust-free* water indefinitely ...Everdur Metal reduces maintenance costs by eliminating all water heater expense due to rust.

Everdur *cannot* rust. It is a rugged, copper-silicon alloy possessing remarkable corrosion-resistance while, at the same time, providing the strength of steel. It is readily welded by all usual methods and is made in all commercial shapes, including tank plates which conform to all requirements of A.S.T.M. specification B96-36T.

Further facts about Everdur Metal for non-rust tanks and heaters are contained in Publication E-10—mailed promptly on request. 36138

ANACONDA from mine to consumer

EVERDUR METAL

"Everdur" is a registered trade-mark identifying products of The American Brass Co. made of copper, silicon and other elements.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Connecticut

Offices and Agencies in Principal Cities

EVERDUR METAL FOR TANKS

A COPPER ALLOY WITH THE STRENGTH OF STEEL

Degree-Days for May, 1936

Continuing HEATING & VENTILATING's eighth year of publishing degree-day data for various large cities in the United States. Degree-day figures for 63 cities are given below.

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for May, 1936	163	1	47	1	183	375	275
Degree-days, Sept. 1, '35 to May 31, '36.	6534	3279	4730	2926	6101	7288	7919
Degree-days, Sept. 1, '34 to May 31, '35.	6653	2764	4371	2305	6324	6874	8082
Degree-days, Sept. 1 to May 31, Normal	6889	2890	4533	2352	6045	6810	7620

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for May, 1936	287	140	75	176	103	159	51
Degree-days, Sept. 1, '35 to May 31, '36.	7379	6878	5599	6404	5984	5721	7270
Degree-days, Sept. 1, '34 to May 31, '35.	6838	6133	4685	5799	5111	5177	6143
Degree-days, Sept. 1 to May 31, Normal	7462	6290	4703	6155	5323	5874	6384

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for May, 1936	166	61	387	3	207	30	122
Degree-days, Sept. 1, '35 to May 31, '36.	7013	5268	10315	2338	6675	4940	6792
Degree-days, Sept. 1, '34 to May 31, '35.	6047	4395	9275	2147	6208	3900	5981
Degree-days, Sept. 1 to May 31, Normal	6490	5034	9245	2428	6266	4264	5934

	Grand Rapids, Mich.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Kansas City, Mo.	La Crosse, Wis.	Lincoln, Neb.
Degree-days for May, 1936	158	94	158	83	23	91	54
Degree-days, Sept. 1, '35 to May 31, '36.	7036	5652	6023	6106	5619	8148	6797
Degree-days, Sept. 1, '34 to May 31, '35.	6457	5311	6087	5122	4622	7228	5571
Degree-days, Sept. 1 to May 31, Normal	6535	5375	6036	5298	4852	7322	6059

	Little Rock, Ark.	Los Angeles, Calif.	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.
Degree-days for May, 1936	1	28	40	127	7	210	111
Degree-days, Sept. 1, '35 to May 31, '36.	3510	1140	4995	8012	3654	7499	8961
Degree-days, Sept. 1, '34 to May 31, '35.	2727	1282	4041	7182	2740	6867	7619
Degree-days, Sept. 1 to May 31, Normal	2811	1504	4180	7395	2950	7206	7850

	Nashville, Tenn.	New Haven, Conn.	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.
Degree-days for May, 1936	16	174	—	135	34	5	59
Degree-days, Sept. 1, '35 to May 31, '36.	4108	5863	1401	5363	3650	3931	7220
Degree-days, Sept. 1, '34 to May 31, '35.	3177	5801	948	5262	3286	3127	5676
Degree-days, Sept. 1 to May 31, Normal	3578	5895	1024	5347	3349	3613	6131

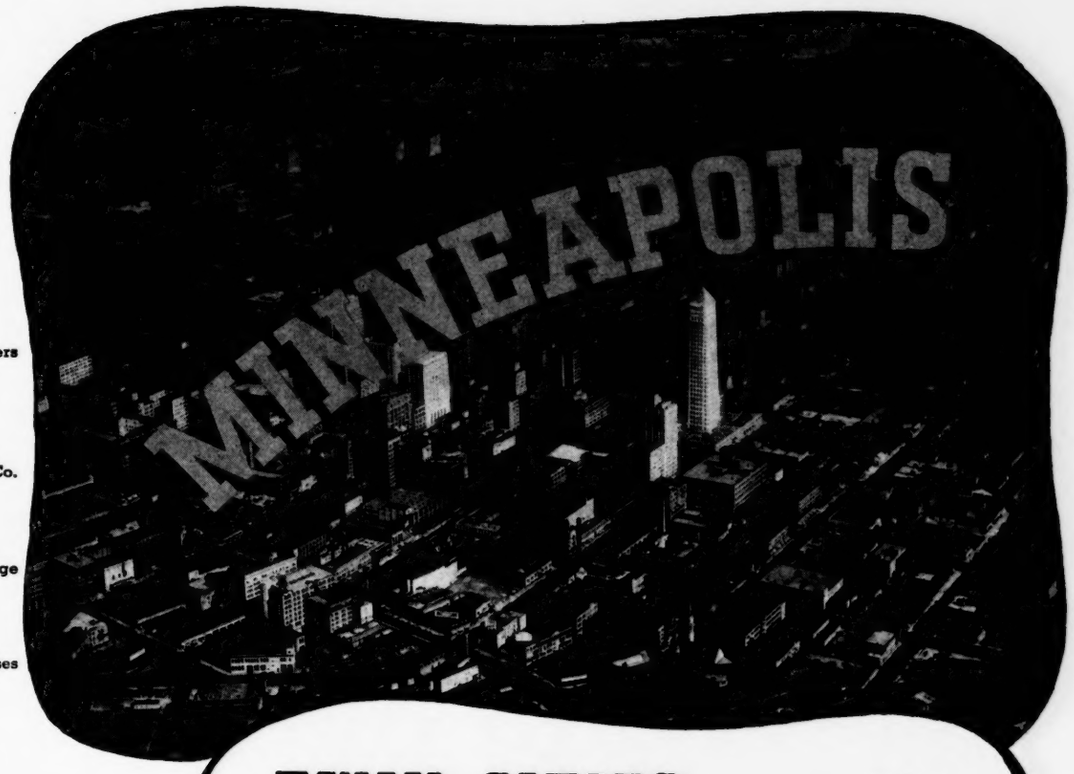
	Peoria, Ill.	Philadelphia, Pa.	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.
Degree-days for May, 1936	72	76	121	321	155	188	100
Degree-days, Sept. 1, '35 to May 31, '36.	6640	4990	5721	6968	4384	5974	5491
Degree-days, Sept. 1, '34 to May 31, '35.	5719	4746	5030	7201	4007	6033	5236
Degree-days, Sept. 1 to May 31, Normal	6109	4855	5235	7012	4379	6014	5389

	Richmond, Va.	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco Calif.	Scranton, Pa.	Seattle, Wash.
Degree-days for May, 1936	28	226	21	137	134	185	196
Degree-days, Sept. 1, '35 to May 31, '36.	4238	6931	5336	5443	2214	6366	4435
Degree-days, Sept. 1, '34 to May 31, '35.	3924	6627	4289	5281	2328	6207	4226
Degree-days, Sept. 1 to May 31, Normal	3725	6732	4585	5555	2682	6129	4716

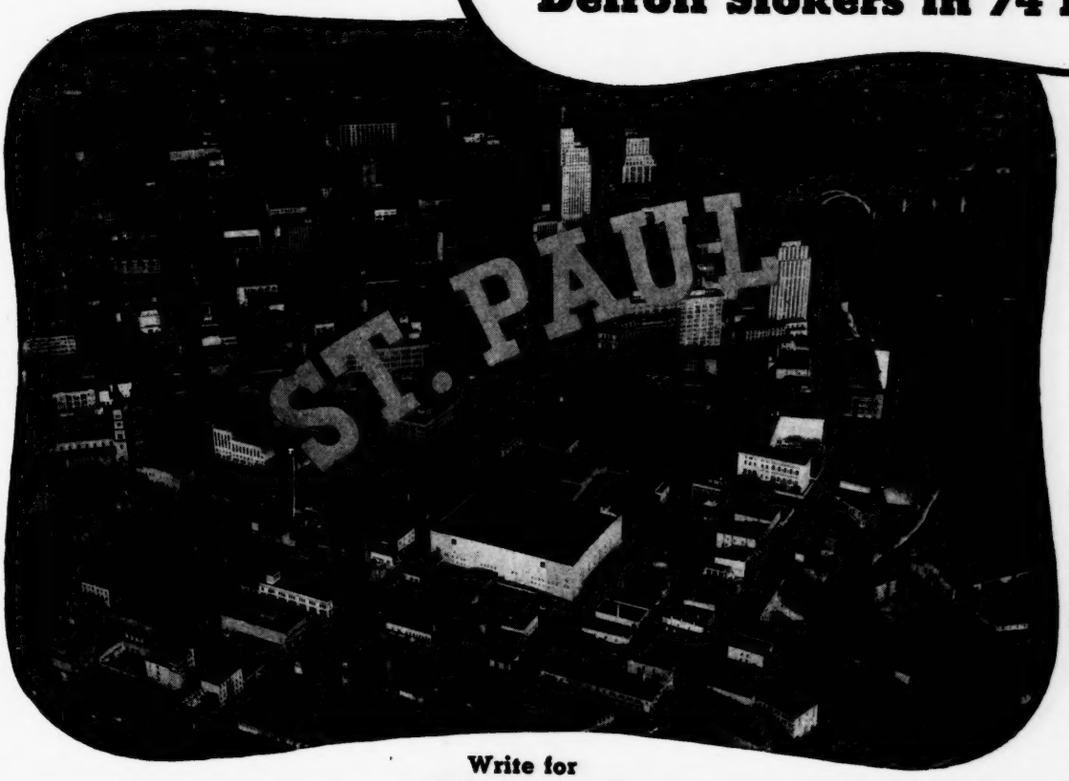
	Spokane, Wash.	Syracuse, N. Y.	Toledo, Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for May, 1936	145	221	140	116	159	55	23
Degree-days, Sept. 1, '35 to May 31, '36.	6427	6851	6788	5492	7005	4740	5039
Degree-days, Sept. 1, '34 to May 31, '35.	5892	6686	6126	5312	7071	4430	4166
Degree-days, Sept. 1 to May 31, Normal	6274	6881	5893	4933	6796	4626	4673

To obtain unit fuel consumption figures for any city shown above, multiply the number of degree-days by the following factors: for coal, 0.008; for oil, 0.00069; for gas, 0.096. Figures obtained will show coal consumption in pounds per square foot of radiator surface; oil consumption in gallons per square foot; gas consumption in cubic feet per square foot—all for the period covered by the number of degree-days. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operation at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal; 140,000 B.t.u. per gal. for oil, and 1,000 B.t.u. per cu. ft. for gas. To correct for other heating values, efficiency and design conditions, follow the method explained in the "HEATING & VENTILATING Degree-day Handbook" or on H. & V.'s Reference Data Sheet Nos. 67 and 68. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

Interstate Elevator
North Star Woolen Mills Co.
McKnight Bldg.
First National Soo Line Bldg.
Powers Mercantile Co.
Metropolitan Bank Building
Minneapolis General Hospital
Young-Quinlan Bldg.
Fairview Hospital
Swedish Hospital
Medical Arts Bldg.
Physicians & Surgeons Bldg.
Curtis Hotel
Lawrence's Launderers & Cleaners
Despatch Laundry
Cream of Wheat Co.
Minneapolis Brewing Co.
Chase Bag Co.
Great Northern Warehouse Co.
Star Elevator
Chute Bldg.
Minneapolis Cold Storage Co.
Northland Transportation Garage
Minneapolis Gas Light Co.
Deaconess Hospital
Holy Rosary Parochial School
Lakewood Cemetery Greenhouses
Oak Grove Hotel
Busch Bros. Greenhouse
Reiss' Greenhouse Inc.
Minneapolis City Workhouse
Robbinsdale School
Republic Creosoting Co.
Minneapolis & St. Louis R. R. Co.



TWIN CITIES . . . use Detroit Stokers in 74 Plants



National Pole & Treating Co.
Vitagraph Bldg.
Hennepin Avenue M. E. Church
Minneapolis Floral Co.
100 North Seventh Street Bldg.
Minneapolis Armory
Ryan Hotel
Mounds Park Sanitarium
Minnesota Bldg.
Collis Products Co.
Yoerg Brewing Co.
Jacob Schmidt Brewing Co.
St. Thomas College
Central High School
American Linen Supply Co.
Mack International Motor Truck Corp.
Transit Supply Co.
Nazareth Hall
Bethesda Hospital
Mechanic Arts High School
R. E. Cobb Co.
Theodore Hamm Brewing Co.
Seeger Refrigerator Co.
Gotzian Bldg.
St. Paul Seminary
Minneapolis-Moline Power Implement Co.
American Crystal Sugar Co.
Board of Education, Stillwater

Write for Bulletin No. 530

DETROIT STOKER COMPANY

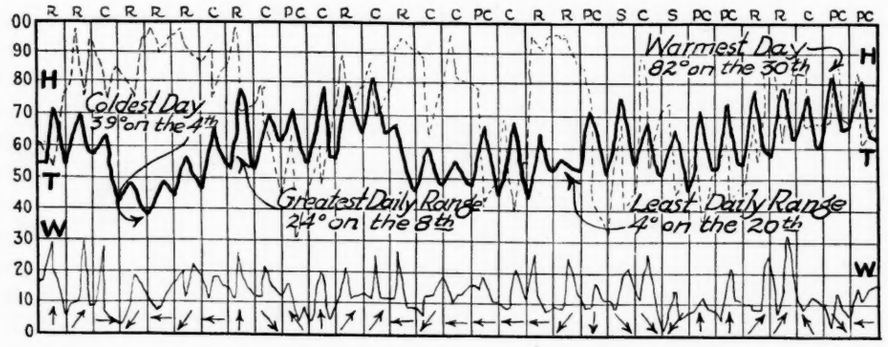
Sales and Engineering Offices: Fifth Floor, General Motors Building, Detroit, Mich.

Works at Monroe, Michigan . . . District Offices in Principal Cities

BUILT IN CANADA AT LONDON, ONTARIO

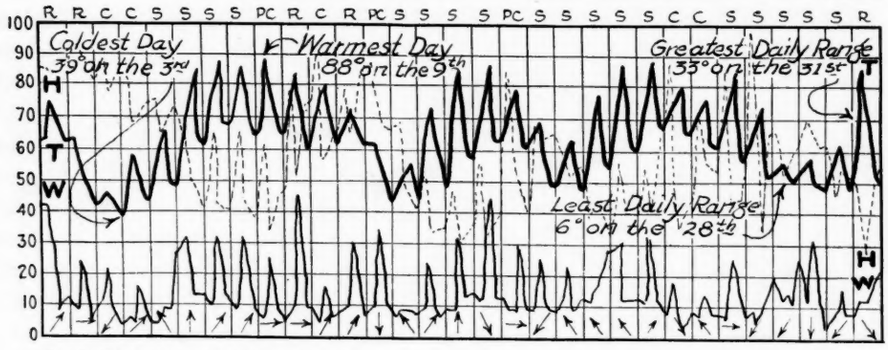
THE WEATHER FOR MAY, 1936

Plotted from records compiled for HEATING & VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.



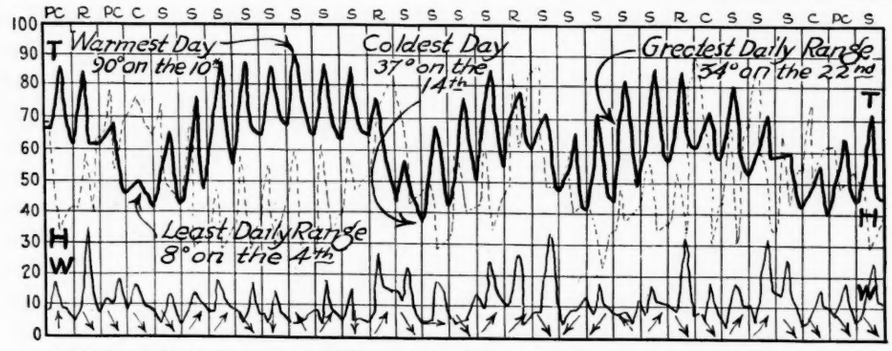
St. Louis

Mean temp. for month, 61.4F; aver. wind velocity, 11.2 m.p.h.; prevailing direction of wind, E.



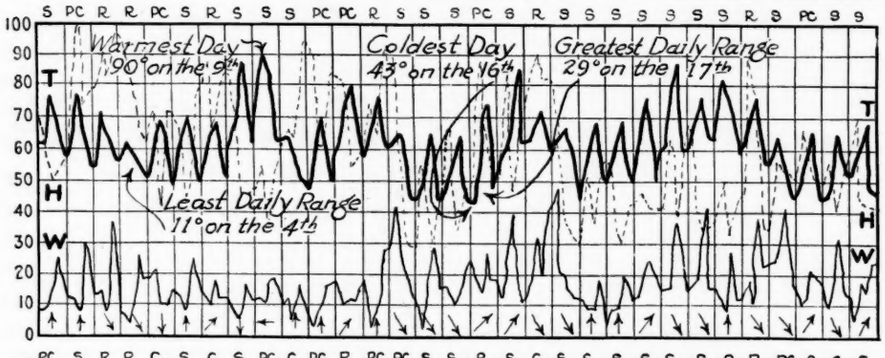
Chicago

Mean temp. for month, 64.4F; aver. wind velocity, 9.7 m.p.h.; prevailing direction of wind, SW.



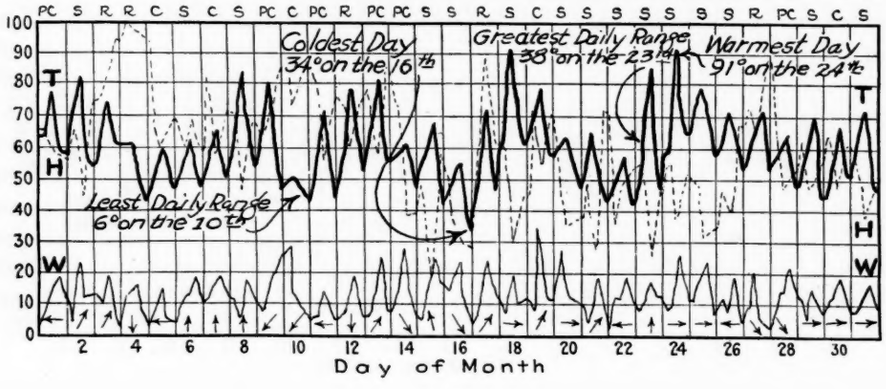
Pittsburgh

Mean temp. for month, 63.6F; aver. wind velocity, 10.0 m.p.h.; prevailing direction of wind, NW.



New York

Mean temp. for month, 62.6F; aver. wind velocity, 15.0 m.p.h.; prevailing direction of wind, SW.


Coldest Day
34° on the 16th
Greatest Daily Range
38° on the 23rd
Warmest Day
91° on the 24th
Least Daily Range
6° on the 10th
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

Boston

Mean temp. for month, 60.6F; aver. wind velocity, 11.2 m.p.h.; prevailing direction of wind, SW.

THEY ASKED: "How can SURFACE solve the control problem?"

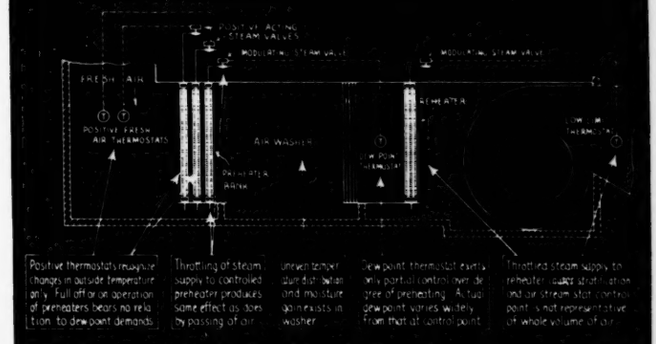
PERHAPS you, too, have wondered: "How can Nesbitt Surface solve the control problem?" The answer is easy. Nesbitt Surface has **dual steam-distributing tubes** inside the regular condensing tubes of the surface. Steam flows first through these distributing tubes and then, through holes placed at proper intervals, to the surface tube, where it is condensed. The quantity of steam issuing from the holes is always equalized, regardless of the volume supplied through the valve. Thus, whether the section is operating at full capacity or is merely tempering the incoming air, **discharge temperatures are uniform over the entire face area of the surface.**

Temperature stratification is eliminated. Close control by air-stream thermostats is made possible. The usual protective tempering coils are made unnecessary—uniform steam distribution prevents frozen tubes. Savings in installation and control costs are effected; and ideal system results are attained.

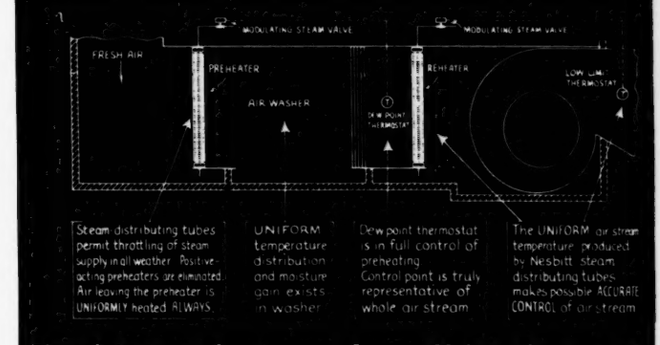
That's how Nesbitt Surface solves the control problem. Its application to a typical humidifying system is illustrated at the right. Send for Publication No. 229, which contains complete information and engineering data.

FRESH AIR
PREHEATER
REHEATER
FACE AND BY-PASS DAMPERS
AIR WASHER
By passed air creates distinct hot and cold streams and the danger of freezing in air washer
Uneven temperature distribution and moisture gain exists in washer
Because of temperature stratification dew point never corresponds to thermostat setting

Disadvantages of By-Pass Control


MODULATING STEAM VALVE
FRESH AIR
REHEATER
AIR WASHER
Positive thermostats respond to changes in outside temperature only. Full off or on operation of preheaters bears no relation to dew point demands
Throttling of steam supply to controlled preheater produces same effect as does by passing of air
Dew point thermostat exerts only partial control over degree of preheating. Actual dew point varies widely from that at control point

Disadvantages of Combined Step-and-Intermediate Steam Valve Control of Ordinary Surface


MODULATING STEAM VALVE
MODULATING STEAM VALVE
FRESH AIR
PREHEATER
REHEATER
AIR WASHER
Steam distributing tubes permit throttling of steam supply in all weather. Positive-acting preheaters are eliminated. Air leaving the preheater is UNIFORMLY heated ALWAYS
UNIFORM temperature distribution and moisture gain exists in washer
Dew point thermostat is in full control of preheating. Control point is truly representative of whole air stream
The UNIFORM air stream temperature produced by Nesbitt steam distributing tubes makes possible ACCURATE CONTROL of air stream

The Solution: Continuous Steam Valve Control of Nesbitt Surface with Steam-Distributing Tubes

NESBITT HEATING SURFACE

with Steam-distributing Tubes

Manufactured by John J. Nesbitt, Inc., Holmesburg, Philadelphia, Pa. Sold by leading manufacturers of fan-system apparatus.

COMING EVENTS

OCTOBER 26-30, 1936. EIGHTEENTH ANNUAL CONVENTION OF AMERICAN GAS ASSOCIATION, *Atlantic City, N. J.*

NOVEMBER 30-DECEMBER 4, 1936. FIFTY-THIRD ANNUAL MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, *Engineering Societies Bldg., New York.*

NOVEMBER 30-DECEMBER 5, 1936. 12TH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING, *Grand Central Palace, New York.*

WITH THE MANUFACTURERS

The Barber Gas Burner Co., of Michigan has taken a long-term lease for a sales office, assembling and service plant, and warehouse, at **4475 Cass Ave.,** Detroit, Mich. While the company is a subsidiary of The Barber Gas Burner Co., Cleveland, Ohio, it has applied for a charter under Michigan Corporation laws, and its principal directors are well known business men. The company will do business in the state of Michigan and western Ontario, Canada.

Carrier Engineering Corp., New York, has appointed a metropolitan Boston dealer for handling comfort air conditioning and commercial refrigeration. The company is known as **Carrier-Boston, Inc.,** 85 Devonshire St., and is under the management of **H. F. Lowe,** who has been associated with Carrier and Brunswick-Kroeschell for the past 16 years. Carrier Engineering Corp. will continue to maintain its Boston office at 1202 Statler Bldg.

Cutler-Hammer, Inc., Milwaukee, Wis., has moved its Los Angeles, Calif., quarters to **1531 Santa Fe Ave.** The office, which is in charge of **W. G. Tapping,** will carry a complete stock of its products.

Electrol, Inc., Clifton, N. J., has been purchased by Morgan J. Hammers of Stamford, Conn., according to a recent announcement. For ten years Mr. Hammers was president of American Nokol Co., and until recently was vice-president and general manager of Petroleum Heat and Power Co., Stamford.

Julien P. Friez & Sons, Inc., Baltimore, Md., has appointed the following representatives: **W. L. Byrne,** 4 Smithfield St., Pittsburgh, Pa., and **Russell R. Gannon Co.,** 519 Main St., Cincinnati, Ohio.

W. W. Grainger, Inc., Chicago, has been appointed authorized resale agent for G.E. fractional horsepower motors. Complete stocks will be carried in Grainger warehouses in Chicago, Philadelphia, Atlanta, Dallas, Boston, San Francisco, Cleveland, New York, Kansas City, Minneapolis, Detroit, and Los Angeles.

Harvey-Whipple Inc., Springfield, Mass., announces the appointment of **Horace W. Bourne** as manager of its direct factory branch at Pittsfield, Mass. Mr. Bourne has been connected with the automatic heating industry for 10 years. For the past eight years he has been sales director for L. R. Seatland, Inc., oil burner dealer of Pittsfield.

Hoffman Specialty Co., Waterbury, Conn., announces that **J. C. Pastor,** Jacksonville, has been appointed representative covering the state of Florida.

Holcomb & Hoke Mfg. Co., Indianapolis, Ind., has appointed **Eastern Sanitary Supply Co.,** Baltimore, Md., as its general distributor in that territory.

The Imperial Electric Co., Akron, Ohio, announces the appointment of **George M. Snodgrass** as general sales manager. Mr. Snodgrass was formerly with Fairbanks, Morse & Co. and the Allen-Bradley Co. He is known for his active work with the National Electrical Manufacturers Association.

(Continued on page 77)

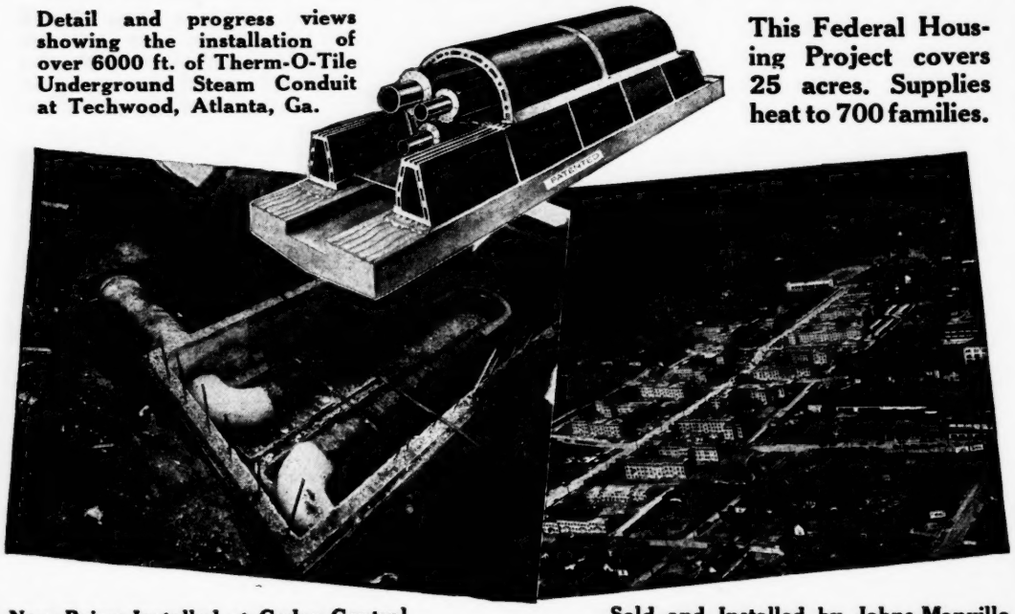
Above—
Welded Bare Pipe.

Right—
Expansion Loop.

Below—
Ready for Backfill.

THERM-O-TILE

Detail and progress views showing the installation of over 6000 ft. of Therm-O-Tile Underground Steam Conduit at Techwood, Atlanta, Ga.



This Federal Housing Project covers 25 acres. Supplies heat to 700 families.

Above—
Insulated Pipe.

Left—
Airplane View of Project.

Below—
Standard Therm-O-Tile Anchor.

Now Being Installed at Cedar Central Housing Project, Cleveland, Ohio. Approved in Specifications for Use in Other Federal Housing Projects.

Ask for Bulletin

Sold and Installed by Johns-Manville Construction Units in all Principal Cities. ***Inquiries referred to them or to us will bring you complete information.***

H. W. PORTER & CO., INC.

825 FRELINGHUYSEN AVE., NEWARK, N. J.

Kelvinator Corp., Detroit, has appointed **G. V. Pollard** general works manager in charge of manufacturing operations at Detroit and Grand Rapids. Mr. Pollard has been director of quality for the company since 1928. Also announced is the organization of a department of public relations to supervise and direct the contacts of the corporation with the public. **Elmer L. Sylvester** will head the department, with the title of director of public relations. In addition, this company is broadening and extending its program of research and development. A field research laboratory has been established on Mark Twain Ave., near the main plant at Detroit, under the direction and supervision of **H. W. Chamberlain.** Operation and application data on equipment developed in the engineering research laboratories are being collected. The corporation has retained the services of technicians in varied allied fields. Among these are: **J. Ivan Dise,** architect; **W. T. Schuett,** construction engineer, and **Edward Heitman,** chief engineer.

May Oil Burner Corp., Baltimore, has promoted **E. Lyell Gunts** to director of sales. Previously serving as publicity and advertising director, Mr. Gunts will continue this work in connection with his new position.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., is continuing to sell the public on the advantages of automatic heating and air conditioning through its advertising in national magazines and newspapers, and to further urge those interested to "See Your Dealer." Its advertising in 1936 began with a campaign in several of the leading national publications, and beginning in August, this advertising will be increased. It will include a continuation of the series of advertisements started early this year and the addition of at least two more national magazines. Moreover, nearly one hundred thousand lines of newspaper advertising in over thirty newspapers in the principal metropolitan centers will be used. The fifty-four million consumer messages in this program will reach every part of the country. Copy in the advertisements will emphasize the advantages of immediate installation of automatic heating and air conditioning, with emphasis on the importance of the dealer and the desirability of calling upon him for information and installation.

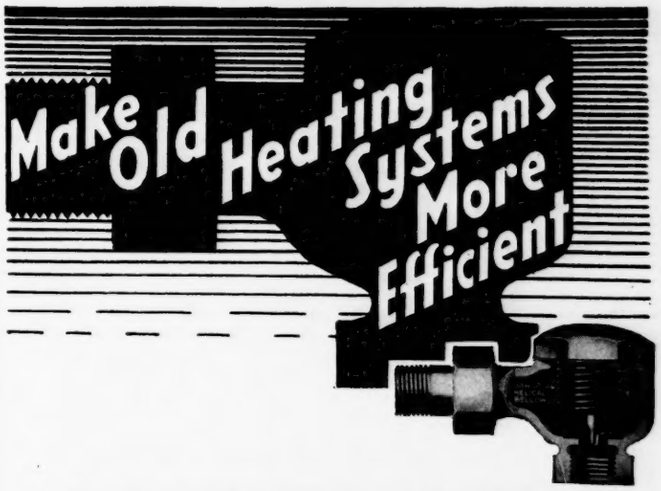
Together with this advertising plan the company is continuing the local meetings of its organization of factory-trained men conducted for the education of salesmen and servicemen. Such meetings, for which the company's personnel is always available, will include presentation of special fall dealer sales helps which are a part of the company's plan for this year's publicity. Such helps will take the form of window and counter display material, in addition to the usual supply of consumer folders and printed matter, most of which is supplied the dealer without cost.

The Herman Nelson Corp., announces the following appointments: **J. F. Finnerty,** formerly istallation and service engineer for Sylvester Oil Co., is in charge of field engineers for Herman Nelson; **H. K. Ricker,** formerly of Gilbert & Barker Mfg. Co., and Colonial Beacon Oil Co., will cover the New England states; **Henry E. Farrow,** formerly branch manager for Gilbert & Barker Mfg. Co. at Springfield Mass., will cover New York, New Jersey, Pennsylvania, and Delaware; **Joseph E. Harrold,** formerly of the Detroit office of Gilbert & Barker Mfg. Co., will cover the East Central states; **C. R. Nickols,** formerly of Williams Oil-O-Matic, will cover the West Central states.

The company's marketing program got under way April 15 when the above division managers returned to their territories after spending a two weeks' training period at the plant and a two-day visit to the Oil Burner Show at Detroit.

Paragon Electric Co., 37 West Van Buren St., Chicago, has completed an extensive factory expansion program at its plant in Manitowoc, Wis. The floor space has been about doubled and new machines installed so that the capacity has been trebled.

(Concluded on page 78)



Heating systems waste coal and do not deliver the heat they should unless all the radiator traps function efficiently. Replace worn traps with Sarco Radiator Traps and you will be surprised at the difference in the coal bills.

Sarco Radiator Traps have a wide opening which permits them to discharge condensate freely. The large thermostatic element, together with the nature of the volatile fluid it contains, insures maximum closing pressure.

SARCO RADIATOR TRAPS

have longer life because the bellows is formed from a single piece of seamless, helically corrugated bronze tubing of large diameter which gives even distribution of the strain over its entire length.

The head is self-aligning and seats perfectly. The seat can be renewed for a few cents.

Sarco Radiator Traps operate without noise and cannot air bind or freeze.

Sarco Radiator Traps have been on the market for nearly a quarter of a century.

The Sarco line also includes Radiator Inlet Valves, Float Traps, Air Eliminators, Boiler Return Traps, Temperature Regulators and Strainers.

Write for our interesting Catalog P-45.

SARCO CO., INC.
183 Madison Avenue., New York, N. Y.
Branches in Principal Cities
Sarco Canada Limited, Federal Bldg., Toronto, Ont., Canada

CONSTANT IMPROVEMENT

by WAGNER

has resulted in

Quieter Air Conditioner Motors

WAGNER has furnished motors for air conditioning equipment for many years and has continuously improved motors for this purpose. Among the outstanding features of Wagner motors are: *(1)* QUIET OPERATION, *(2)* special operating characteristics to meet this exacting service, *(3)* long life, and *(4)* attractive appearance. As a result of Wagner's many years of experience in building motors for air conditioning equipment, Wagner motors are leaders in this field.

A few of the points of superiority of Wagner squirrel-cage motors are:

1. Rotor is of the cast-aluminum type, with bars, end-rings and blowers cast integrally, effecting a one-piece rotor exceptionally sturdy and long-lived. Skewed closed rotor slots minimize magnetic pulsations across the air gap and produce uniform starting torque at different positions of the rotor.

2. The frame and end-plates are strong and rigid, and accurately machined—assuring permanent alignment of bearings and uniform air gap, two essentials for quiet operation.

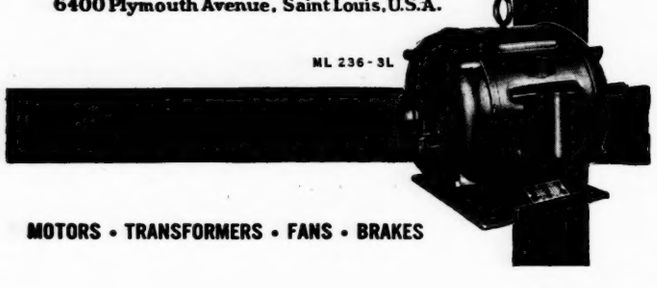
3. Blowers furnished on both ends of the rotor and many large openings in the stator frame insure thoro and unrestricted ventilation.

4. Stator windings are given a superior winding treatment which provides an insulating surface that is oil and moisture resisting and can be easily cleaned.

5. Stator and rotor laminations are punched from annealed, non-aging, high-grade electric sheet-steel selected for its magnetic properties.

Many other features of Wagner motors are worth investigating. Write today for Bulletin 174 which describes the Wagner motors that are Second-to-None for air conditioning.

Wagner Electric Corporation
6400 Plymouth Avenue, Saint Louis, U.S.A.



MOTORS • TRANSFORMERS • FANS • BRAKES

The Rawlplug Co., Inc., New York, announces the appointment of **J. W. Gleason** as general manager of its Chicago office. Mr. Gleason was formerly general manager of the Knapp Bros. Mfg. Co., Joilet, Ill.

Republic Steel Corp., Cleveland, announces that **Cameron and Barkley Co.** of Florida will distribute a complete line of Republic tubular products. The company's Jacksonville and Miami warehouses will stock and distribute the line.

Servel, Inc., Evansville, Ind., has appointed the following distributors: **Scale Sales & Service,** Atlanta, Ga.; **M. L. Hungerford,** New Haven, Conn.; **Appliance Distributors,** Salt Lake City, Utah; **Victory Store Equipment Co.,** Chicago; **Michael Lukac,** Freeland, Pa.; **Shamokin Equipment Co.,** Shamokin, Pa.; **A. S. Hatcher Co.,** Macon, Ga.; **J. M. Gregory,** Jacksonville, Fla.

H. A. Thrush & Co., Peru, Ind., has announced the following extensions in its direct factory sales personnel: In the Philadelphia area, **Leonard D. Grose** will cover the South Jersey territory. Mr. Grose is formerly of the factory production organization and recently in charge of the eastern trailer display unit on sales promotion work. **Earl E. Adams** is appointed direct factory sales representative in the District of Columbia. Mr. Adams was until recently associated with the Anchor Post Fence Co., oil burner division.

Trenton Auto Radiator Works, Trenton, N. J., will announce about September 1 a new unit heater having several unusual design features and with an increased range of capacities.

Westco Pump Corp., Davenport, Iowa, has completed negotiations which will merge that company with the Micro Corp., Bettendorf, Iowa. Both concerns have long been affiliates of the Bettendorf Co. The new concern will be known as the Micro-Westco, Inc. Offices will be located in the Bettendorf Office Building, Bettendorf.

NEW CATALOGS

(Unless otherwise indicated the publishers of catalogs will supply copies on request without charge.)

Alco Valve Co., Inc., 2626 Big Bend Blvd., St. Louis, Mo. A number of loose-leaf folders for this company's catalog. Bulletin 75 is devoted to the Alco types K and E constant pressure expansion valves for ammonia, methyl chloride, and Freon. Bulletin 119 features the types LR, KR, and FR ammonia thermo-valves. Bulletin 144 covers types TL, TCL, TAL, TDL, TBL and TEL thermo-valves for methyl chloride and Freon, and Bulletin 145 describes liquid and suction line filters for methyl chloride and Freon.

American Larson Ventilating Co., Pittsburgh, Pa. A standard-size, 16-page catalog devoted to the company's line of roof ventilators. Attractively made up and contains information not only on the company's line but engineering data relating to roof ventilators. Includes the specifications and dimensions of the various sized units made by this manufacturer.

American Radiator Co., New York, a four-page, standard-size, loose-leaf folder conforming to the new standard form of the company's trade literature, and devoted to Ideal-Arco air, vacuum and vent valves.

American Radiator Co., 40 West 40 St., New York. A 48-page, standard-size presentation entitled "The Cellar Reborn" and showing hobby, play, utility, study, and sports rooms for the basement of the budgeted home. Photographs and plans are accompanied by cost estimates for the carrying out of the installation plan. The photographs before remodeling are of actual jobs while the final photographs are of models which were constructed by students of the

(Continued on page 79)

Parsons School working under the auspices of the American Radiator Co. The students designed the layout, constructed the models, and worked up the cost estimates.

Autovent Fan & Blower Co., 1805 N. Kostner Ave., Chicago, Ill. A standard-size, loose-leaf catalog devoted to the company's complete line and containing charts pertaining to many types of fans and blowers made by the company; its cabinet ventilators, automatic fan and louvers, unit heaters, and electric unit heaters. Charts and dimensional data are given for each item of equipment.

Baker Ice Machine Co., Inc., 1529 Evans St., Omaha, Neb. An unusually attractive, standard-size, spirally-bound, 18-page booklet entitled "Baker Air Conditioning for Commercial and Residential Applications." Ultra-modern in appearance, this publication is a case book of illustrations showing typical and outstanding installations of the company's air conditioning equipment, classified by type of job. Includes illustrations and brief descriptions of the company's major equipments and designs for air conditioning.

Bonney Forge and Tool Works (Forged Fittings Div.), Allentown, Pa. A standard size, 12-page bulletin, No. WT21, entitled "Bonney Weldolets and Thredolets," the company's name for their stock welding fittings. The book is in two colors and elaborately illustrated. In addition to dimensional and capacity data typical installation photographs give a step-by-step description of methods of installing these fittings.

The Bristol Co., Waterbury, Conn. A standard-size, 88-page catalog entitled Bristol Thermometers. Designated as catalog 1250, it is devoted to a complete description of recording, controlling, and indicating thermometers as well as humidity controllers, control valves, and other instruments.

Burgess Battery Co., 111 W. Monroe St., Chicago. Three standard-size, four-page folders. One is entitled Noise and How It Is Measured and describes tone scales and intensity levels, the unit of sound intensity, the noise level meter, and how to use the decibel chart. A second is devoted to the company's Acousti-Pad for absorption of the duct noises in air conditioning systems, and explains the method of calculating the correct amount of this lining to use. The third is also devoted to the Acousti-Pad and treats of methods of installation.

Combustion Control Corp., 257 West Exchange St., Providence, R. I. A 5½ x 8½ in., 20-page catalog entitled The Firemaster, featuring the company's temperature controller. Includes dimensional and descriptive material.

Crane Co., 836 So. Michigan Ave., Chicago. A brochure entitled "A Portfolio of Ideas on Plumbing and Heating." Elaborately bound in heavy black cardboard with special binder and finished in silver and red. It is expected that in the hands of dealers who aggressively follow up prospects it will become the focal center of their sales talks and enable them quickly to close a sale for any type of plumbing and heating material. It is prepared in the form of a presentation, is beautifully illustrated, and contains a minimum of text which is really more in the form of captions than in straight copy. Available to contractors who meet certain qualifications. Size 14 x 10½ in., 40 pages.

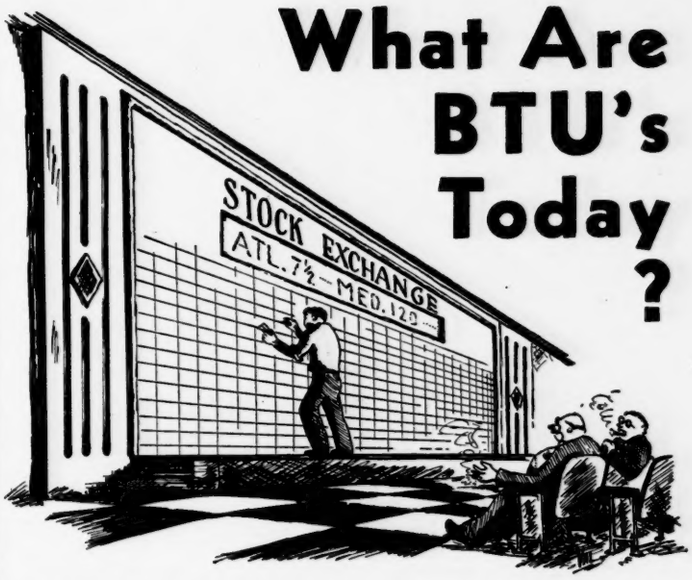
Diamond Power Specialty Corp., Detroit, Mich. A standard-size, 40-page catalog in color designated as Bulletin 884 and entitled "Diamond Automatic Valve Soot Blowers." The bulletin places particular emphasis on the bearings and elements used with the soot blowers, and upon the company's service policies.

Thomas A. Edison, Inc., West Orange, N. J. Standard-size, loose-leaf, 24-page bulletin, entitled Temperature Controls and Thermal Relays, designated as Catalog 36. Gives dimensions, specifications, and applications of company's line.

General Instruments & Controls Co., 205 West Wacker Drive, Chicago. A standard size, four-page bulletin entitled

(Continued on page 80)

What Are BTU's Today?



THE Big Board is not the only place where investments go up or down! Consolidated Power? United Fuel? What are BTU'S today? If BTU'S are down—look for leakage and loss in your underground steam lines. There is no "gambling" when your lines are enclosed in Ric-wiL Conduit—a safe investment.

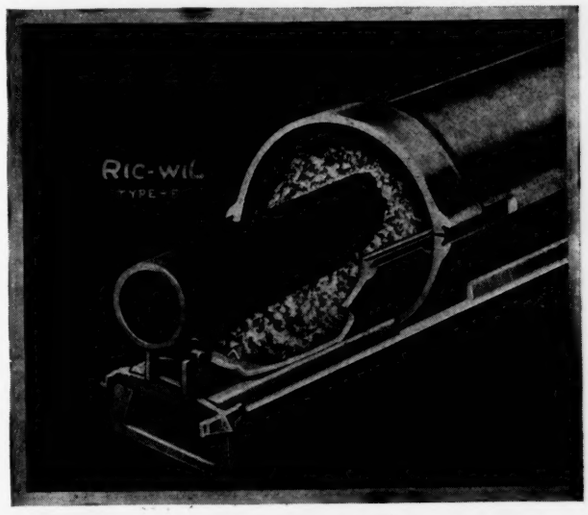
Ric-wiL Conduit keeps underground steam lines tight, dry, and 90% or more efficient. Various designs in both standard weight Tile and Super Tile, in Cast Iron, and in Armco Iron Unit Steam Main. Famous Dry-paC Waterproof Asbestos Insulation, or other optional insulations. Ric-wiL offers a thoroughly engineered service, adequate to any problem in the field of sub-soil steam conveyance. Installation instructions, engineering service drawings, also field supervision if desired. Catalog promptly on request.

The RIC-WIL Co., Union Trust Bldg., Cleveland, O.

New York San Francisco Chicago

Agents in principal cities

According to ASHVE Research Bureau, heat loss from conduit in wet soil is over *four times* that in dry soil. Ric-wiL External Base Drain keeps the soil *dry*.



REGISTERED IN U. S. PATENT OFFICE

Ric-wiL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

Akron Savings & Loan Building, Akron, O.

MODERNIZE HEATING IN AKRON BANK BUILDING

Webster Hylo System Is Selected After Exhaustive Investigation

Akron, O.—The engineering experience of the Webster Organization was a determining factor in the selection of the Webster Hylo System of Steam Heating and Webster Heating System Equipment in the Akron Savings & Loan Company Building, according to Building Manager A. B. Crandall.

The heating system in this 12-story office building was brought up-to-date during the 1934-35 heating season after an exhaustive investigation of heating control methods.

"While our primary object in installing the Webster Hylo Control System was to obtain even temperature and tenant comfort, it is interesting to note that a 19 per cent coal saving was also effected."

The Webster Hylo Steam Variator—a simple, rugged central control for use with Webster Systems where distribution of steam to all radiators is balanced by accurately sized metering orifices. The Hylo Variator Valve Operator (illustrated) automatically throttles a rugged motor-operated valve in the steam main.

How this 19 per cent saving was achieved is shown in the performance record below. There was no change in the heating schedule of 91 hours a week.

Heating Performance Record

	Degree Days	*Lbs. Coal Fired*	*Steam Per D.D. Per M. Sq. Ft. Radiation*
Before Control 1933-34.....	6,566	875,000	79.5
After Control 1935-36.....	6,728	730,000	64.5

Data for season 1934-35 is not conclusive, as change was made during the heating season.

If you are interested in heating *new* buildings, or in improved heating service and lower heating cost in your present building, address

Warren Webster & Company . . . Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Branches in 60 principal U. S. Cities . . . Darling Bros., Ltd., Montreal, Canada

Instruments for Air Conditioning. A condensed catalog of this firm, which is a factory representative for Friez, includes that company's instruments and several other instruments, including a direct reading air velocity meter.

Gorton Heating Corp., Cranford, N. J. Bulletin 102. A standard size, 8-page catalog featuring the company's single pipe vapor heating system.

Grand Rapids Die & Tool Co., 113 Michigan St., N.W., Grand Rapids, Mich. A six-page, standard-size bulletin featuring the company's Properaire blower-filter unit, available with 10 and 12 in. blowers. Fan wheels, draft blowers, and dust collectors are also described.

Hancock Valve Division, Consolidated Ashcroft Hancock Co., Inc., Bridgeport, Conn. A bulletin describing the company's line of forged steel valves designed for steam pressures up to 1,500 lb. per sq. in. The makers claim these valves are intended to reduce valve replacement and maintenance costs. Includes capacity, dimensional, and specification data, and illustrated with photographs and line drawings. Standard size, 20 pages.

Iron Fireman Manufacturing Co., Cleveland, Ohio. Catalog 3905, giving detailed information on the new pneumatic spreader, said to be the first stoker to bring the advantages of the pneumatic conveying system to steam size coal. Drawings of typical settings under various types of boilers complete the 12-page catalog. Standard size.

Kewanee Boiler Corp., Kewanee, Ill. Catalog 84h, showing Kewanee type C boilers conforming with industry simplified practice recommendation. In accordance with this Steel Heating Boiler Institute code for rating low pressure heating boilers, the number of type C boiler sizes has been reduced from 22 to 18.

Link-Belt Co., 307 N. Michigan Ave., Chicago. Three booklets on automatic firing with coal, for boilers up to 300 hp. Booklet 1541 covers the series of automatic coal burners for the home; No. 1537 shows applications of Link-Belt stoker firing to commercial heating plants; and No. 1538 covers automatic generation of process steam, high or low pressure. The foregoing literature covers stokers for bituminous coal. The anthracite series of automatic coal burners, built in Philadelphia, is illustrated in folder No. 1522.

Marsh Tritrol Co., Chicago, Ill. A standard-size, 12-page booklet devoted to an explanation of the method of operation of the March Tritrol regulator, listing its advantages and applications. The Tritrol regulator is a device which regulates the heat supply to a building in accordance with the predetermined heating program. Program is automatically selected for varying weather conditions.

The McAlear Mfg. Co., 1901 S. Western Ave., Chicago. A bulletin covering the company's complete line of liquid level controllers, diaphragm motor valves, lever valves, float valves, and other devices for the control of pressures and levels.

National Airoil Burner Co., 1327 Girard Ave., Philadelphia. A standard size, six-page folder describing the company's Nairoil automatic oil burners, Models E and J, the latter having just been added to the company's line and being available in five sizes for very large homes and medium-sized apartments and larger buildings.

The Northern Blower Co., West 65 St., South of Denison, Cleveland, Ohio. Bulletin 1002-2 entitled Norblo Slow Speed Low Power Exhaust Fans. Gives capacities and dimensional data relating to the company's exhaust fan for dust collecting equipment.

Owens-Illinois Glass Co., Toledo, Ohio. A standard-size, 24-page bulletin in green and black devoted to the company's Insulux glass masonry. In addition to dimensional and other specification data, drawings relating to interiors, store front designs, and similar installations are treated at some length. Contains basic specifications together with estimate data.

(Concluded on page 81)

Pangborn Corp., Hagerstown, Md. Industrial Dust Control Through Exhaust Systems, by W. C. Vedder. A 54-page book written for the purpose of acquainting plant executives with the means of controlling industrial dusts at the source of production. Charts the progress made by various types of dust collecting systems to the present time, and includes chapters on exhaust hoods and piping system; dust collecting equipment; types of collectors in general use in the industrial field; exhauster and drive; operation and maintenance of exhaust systems. Attractively printed and bound; 5¼ x 7¼ in.

Practical Instrument Co., 2717 N. Ashland Ave., Chicago. An eight-page folder describing the company's 24-hr. recording thermometers.

Reliance Gauge Column Co., 5902 Carnegie Ave., Cleveland, Ohio. An 8-page catalog-folder, containing complete information regarding float-operated safety water columns, accompanied by descriptive illustrations. In addition, the folder contains detailed size and price lists, including technical specifications of fittings, installations, etc., and material on monel metal floats, with illustrations of assembly and float tests. A discussion of safety water column installation is included in the text, together with pictures of industrial applications. The ASME code requirements for water glasses and gauge cocks appear in the folder.

Sarco Co., Inc., 183 Madison Ave., New York. A single sheet, standard-size folder devoted to the company's water blender for automatically mixing hot and cold water and other fluids and delivering the mixture at any predetermined constant temperature. Especially adapted for use with hot water heaters and for other applications in air conditioning, cooling, and refrigeration.

Standard Fuel Engineering Co., 667 S. Post Ave., Detroit. The Standard Hand Book of Refractories, a 48-page, 6 x 9 in., manual of information for engineers, plant superintendents, and others interested in the control of heat. Contains information on refractory cements, refractories, heat treating and other furnaces, as well as useful tabular material of interest to those whose use of refractory materials requires specific formulas. Illustrated from actual photographs of typical installations of a wide range of refractories. Printed in a format which makes the book a handy pocket manual for the active engineer.

ABSTRACTS

(Concluded from page 64)

ing the use of these factors in a typical air conditioning problem.

After determining the amount of the sensible heat load, his next step is to calculate the air quantities, amount of supply air, return air, outside air, and dehumidified air. At the end of this chapter he gives a further extension of the example presented in the preceding chapter so as to include the air quantity calculations.

The author's third step is to determine the latent heat gain, while his fourth step is to determine the refrigeration load. In this chapter he also gives a brief discussion on the selection of the refrigerant. He then takes up the use of dehumidifiers as against surface cooling. Calculations showing the method of selecting the sizes or capacities of dehumidifiers and surface cooling are shown. A discussion of evaporative cooling and an example to illustrate the type of calculation for this type of cooling are presented in the seventh chapter.

The eighth chapter contains an explanation of the effect of high altitudes on air conditioning systems and the method of calculating the pressures for altitudes is presented.

[*"How To Figure Air Conditioning," by Harold M. Hendrickson. Published by the American Society of Refrigerating Engineers, New York. Cloth bound, 6 x 9 in., 56 pages; price, $1.*]

Announcing

AEROFIN

Direct Expansion Cooling Coils with Exclusive Centrifugal DISTRIBUTING HEADER

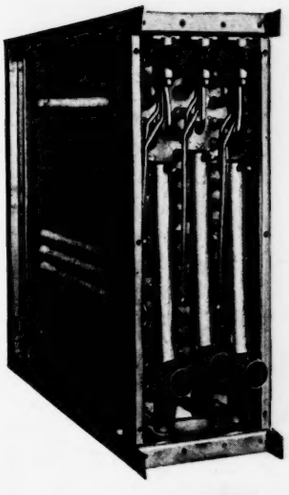
Aerofin Direct Expansion with new Centrifugal Distributing Header, designed to meet changing conditions in air conditioning practice.

Below: Aerofin Direct Expansion with standard distributing and suction headers allowing control for each row.

THE new Aerofin Centrifugal Distributing Header for direct expansion cooling coils is the result of extended research and extensive field tests.

It provides a proven method for automatically distributing the refrigerant evenly through all circuits of the evaporator where only one connection for each coil is required. It saves costs on installation, is simple and fool-proof.

This distributing header, like all standard Aerofin equipment, minimizes pressure loss. Made in 2 to 6 rows of tubes in standard 10" depth casings.



New Supplement to Bulletin D. E. 34, gives complete tables and curves for selecting proper size and type. Permits accurate determination of final air condition leaving coil. Send for your copy today.

AEROFIN is sold only by Manufacturers of Nationally Advertised Fan System Apparatus. — List upon Request

AEROFIN CORPORATION
850 Frelinghuysen Avenue
Newark, N.J.
Chicago Detroit New York Philadelphia

• of Individual Radiators

Sylphon Automatic Radiator Valves—simply used to replace ordinary radiator valves in one room, a suite or an entire building—regulate the flow of steam to each radiator according to the individual room's comfort requirements.

Because these self-contained and self-powered reliable controls cost so little, are so easy to install in new or old buildings without alterations, and return so much in tenant satisfaction and fuel economy—they are a paying investment in any modernization project, large or small.

Made in types for both exposed and concealed radiation. This latter exclusive two-bulb balanced heat control, illustrated, utilizes both incoming cool air and outgoing heated air from the enclosure to maintain desired temperature at the breathing line. Installed entirely within the enclosure, out of sight—only the attractive adjustment knob is visible. See new bulletin below.

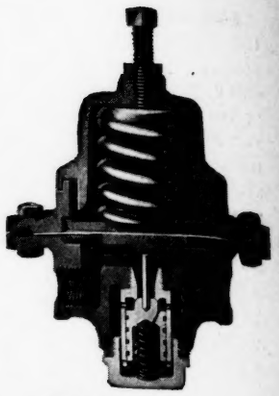
NEW SYLPHON BULLETINS OFFERED

Individual Room Temperature Control—Bulletins NH 80 and NH 70 . . . Zone Control—Bulletin NH 70 . . . Space Heat Control in Large Industrial Areas—Bulletins NH 50 and NH 70 . . . Duct Type Heating and Air Conditioning Controls—Bulletin NH 50 . . . Service Hot Water Supply Control—Bulletins NH 20 and NH 40 . . . Drinking Water Temperature Control—Bulletin NH 20.

FULTON SYLPHON CO.
KNOXVILLE, TENN., U.S.A.

Sales Representatives in Principal Cities

Designed for your Convenience!

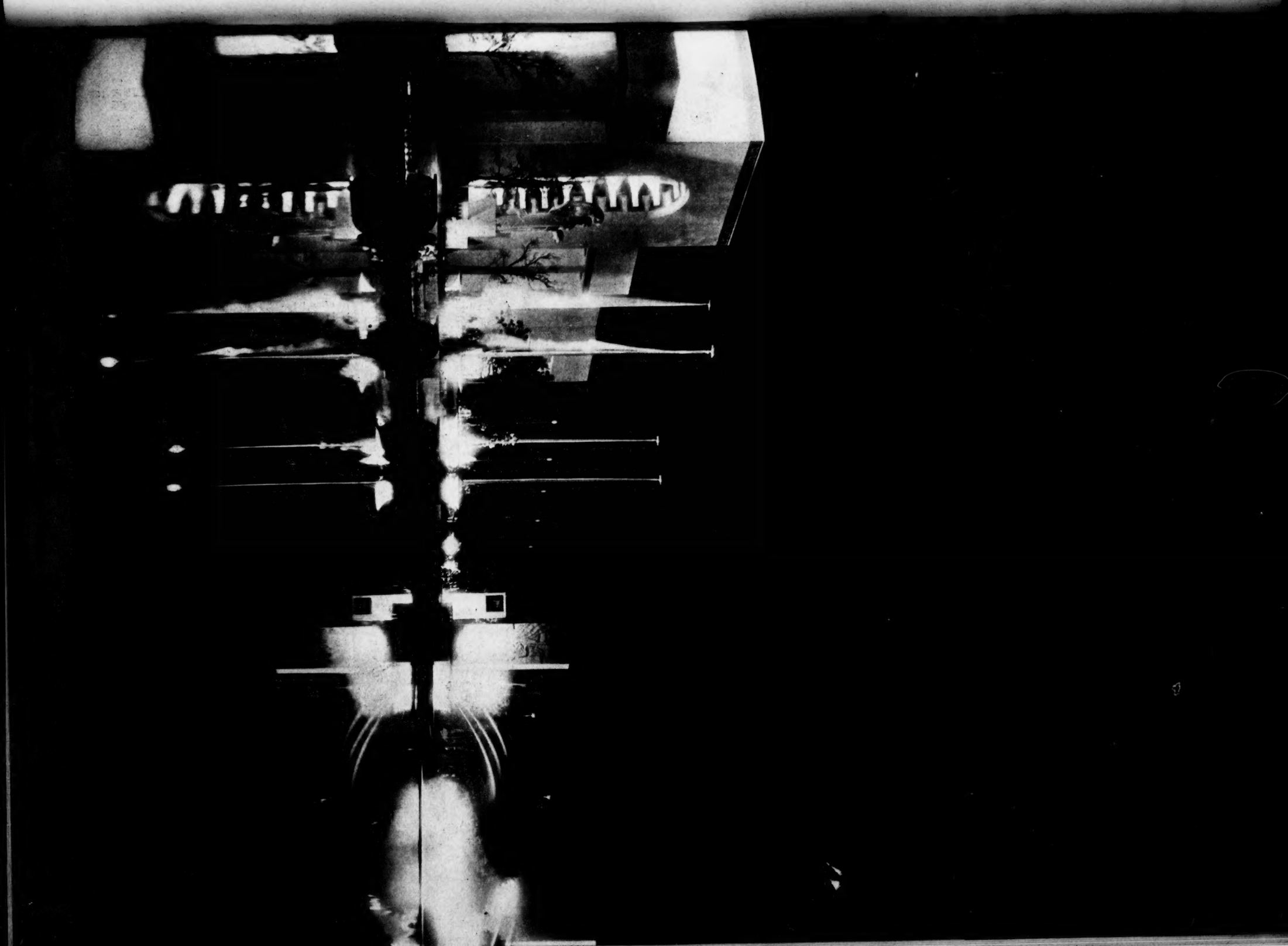


The DAVIS No. 13 Pressure Regulator

CONVENIENCE in installation, operation and maintenance has long been recognized as a most desirable characteristic for any device; nevertheless, it is unusual to find such a wealth of advanced features as are offered by the No. 13 Davis Pressure Regulator. Here are just a few of the advantages offered: spring removable without breaking diaphragm seal . . . built-in strainer . . . . all interior parts accessible without breaking pipe connections . . . . Valve closes tight on dead end and can maintain pressure reduction regardless of circulation . . . . greater valve opening minimizes wire drawing. The No. 13 is especially recommended for use on unit heaters, laundry machines, hospital sterilizers, and kitchen appliances. Easily adjustable in three reduced pressure ranges: 1 to 20, 20 to 50, and 50 to 100 pounds for steam, gas, water and air service.

Ask for Bulletin 100.

DAVIS REGULATOR COMPANY
2553 S. Washtenaw Avenue Chicago, Illinois

The new Micro-switch safety pilot control of Humphrey Gas Unit Heater breaks the motor circuit and shuts off the gas automatically in event of pilot failure. For the past seven years, Chace Thermostatic Bimetal has been used exclusively as the active element in Humphrey pilot controls. Where automatic action or control of temperature is desired, investigate Chace Thermostatic Bimetal.

W. M. CHACE CO.
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